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EDITORIAL

THE NATURE OF THE ELEMENTS.

The conception of the element as an undecomposable and fixed form of matter, and the conception of the atom as an indivisible and irreducible particle have dominated chemistry for many years. The conception of the atom, indeed, dates from the early Greek philosophers, but was not fully validated in chemical theory until the work of Dalton in the early part of the nineteenth century. The standard conception of the element dates in the main from Boyle's work in the latter half of the seventeenth century.

Both views have gone by the board. The atom is now considered as made up of two different masses, nucleus and electron, and the convertibility of elements has been demonstrated in a number of cases, and it has, moreover, been shown that individual elements may be made up of several forms of matter. During the latter half of the nineteenth century, the spread of the theory of evolution among naturalists influenced chemists towards thoughts that possibly the elements are modification of a primordial form. The existence of some groups closely related in properties, physical and chemical, assisted this tendency. Many chemists leaned toward the view that chlorine, bromine and iodine might be of common parentage, and similarly iron, nickel and cobalt; calcium, barium and strontium. Prout, an English chemist, published in 1815 a suggestion that the atomic weights of all elements are simple multiples of that of hydrogen, a view to which many assented, but careful determinations of many atomic weights showed that some elements, at least, gave fractional numbers, among which chlorine is very conspicuous.

About the beginning of the present century, a change came over the fundamental philosophy of chemistry. The discovery of the nature of the atom, and the demonstration of the spontaneous formation of radium from uranium and radium into helium, upset the theories of atomic indivisibility and inconvertibility. At present, Prout's theory has returned to favor, for the apparent exceptions to it are now generally recognized as due to existence in the mass of a given atom of several subsidiary systems with slightly different weight relations. While each of these systems may have a whole number weight, the association of two or more in a certain ratio will give a fractional figure to the mass of the acting element. Thus, the accepted atomic weight of lithium is 6.94, but it is considered as being made up of two atomic systems, always associated in the same proportion, as far as known, having respectively weights 6 and 7. The atom of tin is considered as made up of about eight systems ranging in weight from 116 to 124. Inasmuch as the difference between the extreme weights of the systems entering into a given atom are too slight to place them in a different position in the periodic table, the several systems of each atom are termed "isotopes" (from Greek words, meaning "equal place"). It has also been found that subordinate systems of equal weight may occur in different atoms, but not necessarily identical. Thus, argon is given two isotopes, 38, 40, associated in such proportion as to give an atom weight of a little less than 40, and calcium is given also two isotopes, 40 and 41, associated in such proportion as to give an atom weighing a little more than forty, but the two 40 systems are not identical, and are distinguished as "isobares." (It is to be hoped that this term will be pronounced with the "a" long—riming with "fare"—for the word "isobar" is now in regular use in meteorology to indicate lines of equal barometric pressure.)

We will, thus have two kinds of atomic weights, those of the isotopes and those of the associated systems, the latter being the atomic weights, as used in practical chemistry. It is interesting to note that so far as yet ascertained, the four elements of biologic chemistry, carbon, hydrogen, nitrogen and oxygen, have not exhibited isotopy, but some other elements of less importance are also in this simple list, possibly because research has not yet undertaken their study.

In an extended article on "The Modern Development of the Theory of the Chemical Elements and the Atoms," appearing in the *Ber. d. Deutsch. Pharmaz. Gesell.* (1924, 34, 183), the author, W. Herz, offers a revised definition of an element. Inasmuch as it may be assumed that all atoms are made up of the hydrogen nucleus (termed by Rutherford "proton"), and a certain number of electrons, these are the true elements. For practical purposes, however, it is necessary to maintain the vogue of the term "element" in the old sense, practically as laid down by Boyle, in the seventeenth century, inasmuch as this significance has great value for the expression of chemical changes and the application of the periodic system.

For the routine work of the chemist, the old conceptions of the element and the atom suffice. The decomposition by chemical or mechanical means of a given atom as carried out by Rutherford and others is a specific incident and spontaneous decomposition, such as uranium into radium is limited to the radioactive group, and further, a group of isotopes, as in chlorine, act as one in almost all physical and chemical relations, so that the manifestations of isotory are exceptional. Herz suggests a definition of an element. "In the application of the periodic system, an element is a material that has a characteristic Röntgen spectrum, or in other words possesses a specific nucleus charge." The doctrine of the unity of each element must be relinquished. Panert has, indeed, suggested a distinction between "pure elements" and "mixed elements" applied respectively to those which have but a single system of nucleus and electron and those which have two or more. Fajans, however, prefers to consider each association of nucleus and electrons as an element. Decision on this point must be left to further research, yet it is worth noting that the caustic alkalies were considered elements until Davy decomposed them by electrolysis, and that for many years didymium stood unchallenged with its associates cerium and lanthanum until broken into neodymium and praseodymium. It can hardly be regarded as of no significance in the evolutionary relation that neodymium salts are red and praseodymium salts green.

HENRY LEFFMANN.

ORIGINAL ARTICLES

CHEMISTRY IN AND ABOUT THE HOME.*

By Freeman P. Stroup, Ph. M.

In our everyday life we are constantly in touch with chemical processes. Our very bodies are chemical factories, so to speak, in which are going on, day and night, year in and year out, without vacations or "time off" for any purpose, chemical processes of building up and breaking down, all vital processes being accompanied by chemical changes. When life ceases it is because the synthetic processes in the human factory can no longer take care of the raw materials brought into it nor the by-products formed in its operation. It ceases to function as a productive organization for the benefit of mankind, and like a man-made factory which is no longer of use in the world, it begins to decay and, sooner or later, as the result of other chemical processes, the complex substances of which it was built will be resolved into simpler ones and made a part of "the dust of the earth."

In our workshops, on the farm, in the home—everywhere we go—there are constantly going on chemical processes which make for our happiness or unhappiness; and it is of some of these that I wish particularly to speak this evening. Just at this season of the year (late in November), with cold weather at hand or not far off, and the price of coal, our chief fuel, nearly out of the financial reach of many, a discussion of some of the problems arising from the heating of our homes, places of business and amusement, would seem to be of very general public interest; so, as the subject is a large one, I shall confine myself chiefly to that phase of everyday chemistry. Perhaps, at some future date, there will come an opportunity to take up the chemistry of the kitchen as it applies to cooking, baking, cleaning, etc.

Fuels.

Fuels are substances which burn more or less readily in air, producing heat cheaply enough to permit its use for industrial and domestic purposes. In this part of the country (eastern Pennsylvania)

*A lecture delivered at the Philadelphia College of Pharmacy and Science, Thursday evening, November 22, 1923, the fourth of the 1923-1924 series of Free Popular Science Lectures.

vania) the chief domestic fuel is anthracite, often called "hard coal." Some bituminous coal (so-called "soft coal") is used, mainly, however, for industrial purposes, and, in recent years, both kinds of coal have been replaced, to some extent, both for industrial and domestic purposes, by "fuel oil" (sometimes a crude petroleum and sometimes a by-product in the manufacture of other petroleum products). Domestically, these are burned largely in furnaces (usually placed in the cellar of the home) and, to a lesser extent, in small heating stoves, cook stoves or ranges. Gas, kerosene (locally called "coal oil"), and occasionally charcoal and coke are used in stoves designed for heating small rooms and in ranges for culinary purposes. Gasoline is only occasionally used, as most people are justly afraid of it because of its volatility and the ready inflammability of mixtures of its vapors and air. Alcohol (generally "denatured") finds some use in the heating of samovars, chafing dishes and other apparatus which it is desired to heat for only a brief space of time. In this section wood is too expensive for general use as a fuel, but waste wood finds wide use as a kindling material for less easily ignited substances.

Chemical Composition of Fuels.

Chemically, charcoal, coke and anthracite are chiefly carbon, while bituminous coal is largely carbon with varying amounts of compounds of carbon and hydrogen (so-called hydrocarbons). Gasoline, kerosene and fuel oil are complex mixtures of hydrocarbons, while wood is mainly cellulose and lignin, both being compounds of carbon, hydrogen and oxygen. Natural gas, much used in some parts of the country, is a varying mixture of gaseous hydrocarbons, while "gas" (as manufactured and sold in most communities of any considerable size) is a mixture of hydrogen, hydrocarbons and carbon monoxide. Alcohol is a definite compound of hydrogen, carbon and oxygen, to which the chemist gives the formula C_2H_5OH , and wood alcohol, used for denaturing ordinary alcohol, and also in the more or less pure form for small lamps, often sold under trade names, while a carbon-hydrogen-oxygen compound, has been given the formula CH_3OH . Doubtless, you will have noted that all of the substances used as domestic fuels contain carbon and most of them hydrogen.

Chemistry of Combustion.

When hydrogen burns it is because it combines chemically with oxygen (which constitutes about one-fifth of the air by volume), the product of the combination being water (the chemist often writes it H_2O) in the form of vapor. If we hold an inverted cold glass vessel (a tumbler or goblet will do very nicely) over the flame of burning gas, gasoline, kerosene, alcohol, wood or a candle, we soon observe a cloudiness on the inner surface of the vessel, due to the condensation of some of the water vapor formed in the combustion of the hydrogen of the burning material. Again, who among us has not noticed, as some time or other, when a vessel (a teakettle, for instance) filled with very cold water was put over an open gas fire, that the bottom got wet in a few minutes, sometimes wet enough to cause a drip into the fire, and who has not on such occasions been fearful that the vessel had "sprung a leak"? In the future don't worry—the drip only represents condensation of water vapor formed in the burning of the hydrogen of the gas. The richer the gas in hydrogen the greater will be the amount of water formed. Yet again, when liquid air in a kettle is put over the open gas fire the cold produced in the evaporation of the liquid air is so great as not only to condense the water vapor to the liquid form but also to freeze it solid, so that we see the curious spectacle of ice forming in direct contact with a flame from gases produced in the flame. The amount of heat liberated in the burning of hydrogen is very great and, in a general way, we can say that the larger the percentage of hydrogen, either free or combined, in a fuel, the greater the heating value.

When carbon burns it is because it combines chemically with oxygen to form an oxide of carbon, with the liberation of a considerable amount of heat. There are two of these oxides of carbon—carbon monoxide (CO) and carbon dioxide (CO_2), the latter containing twice as much oxygen as the former in proportion to the carbon. In the formation of carbon monoxide less than one-third as much heat is developed as when carbon dioxide is formed, perhaps the most important fact for all users of fuel to remember, particularly as the formation of the latter instead of the former means, ordinarily, only the supplying of a little more air to the burning fuel, and air is still "free."

Heating Values of Fuels.

The heating value of a fuel may be expressed in several ways, *viz.:*

- (1) The small calorie ("calorie," abbreviated "cal."), which represents the heat required to raise the temperature of one gramme of water one degree Centigrade;
- (2) The large calorie ("Calorie," abbreviated "Cal."), which represents the heat required to raise the temperature of one kilogramme (1000 grammes) of water one degree Centigrade;
- (3) The British thermal unit (abbreviated B. T. U.), which represents the heat required to raise the temperature of one pound (avoirdupois) of water one degree Fahrenheit.

One (1.0) degree Centigrade (C.) is equivalent to 1.8 degrees Fahrenheit (F.), and 1 kilogramme (Kgm.) is equivalent to 2.2 pounds (lbs. av.), hence 1 Cal. (1.8 x 2.2) is the equivalent of 3.96 B. T. U.

The approximate heats of combustion of the common fuels, and of some other substances mentioned in this lecture, are as follows:

	B. T. U. per Lb.	Cals. per Kgm.
Hydrogen	62,000	34,462
Carbon (to Form CO)	4,450	2,475
Carbon (to Form CO ₂)	14,600	8,100
(Coke and Charcoal Are Mainly Carbon.)		
Carbon Monoxide (CO)	4,370	2,425
Methane (CH ₄)	24,000	13,300
(Methane is the Chief Constituent of "Dry" Natural Gas, and a Constituent of Many Varieties of Artificial Gas.)		
Gasoline (Average, C ₈ H ₁₄)	16,340	9,080
Kerosene	18,000	10,000
Alcohol (C ₂ H ₅ OH)	12,700	7,000
Hard Wood (Oak)	8,300	4,600
Soft Wood (Pine)	9,150	5,100
Bituminous Coal	14,440	7,500
	to 15,300	to 8,500
Anthracite	15,650	8,700
	to 15,800	to 8,800
B. T. U. per Cubic Foot		
Natural Gas	900 to 1,135	
Coal Gas (From Distillation of Soft Coal)	500 (Average)	
Water Gas (Chiefly Hydrogen and Carbon Monoxide)	300 (Average)	

Reduced to simple figures, the relative heating values of the common fuels, based upon the amount of heat produced from a unit weight of substance burned, is, roughly, as follows: Hard wood, 9; soft wood, 10; soft coal, 15 to 17; coke and charcoal, 16; hard coal, 17.5; kerosene, 20; fuel oil, above 20; natural gas, as high as 40, depending upon composition.

The consumer who wishes to make comparisons of various fuels as to heating values and costs is confronted with a number of difficulties. The heating values are generally based upon the combustion of unit *weights* (gramme, kilogramme or pound avoirdupois), but liquid fuels (gasoline, kerosene, fuel oil) are generally sold by *measure* (gallon or barrel), gaseous fuels (natural and artificial gas) are sold by the *cubic foot* or a multiple of it, wood is sold by the *cord* (which term, by the way, does not always mean the same amount of wood, either by weight or by volume), hard coal is sold by the "long" ton (2240 pounds), coke and soft coal are sold by the "short" ton (2000) pounds, or by the bushel, and charcoal is generally sold by the sack.

Efficiency at the Furnace.

In the use of charcoal, coke or anthracite, firing and the regulation of drafts has to be very carefully done, if one is to avoid sending a lot of the heat units of the fuel "up the flue" in the form of carbon monoxide, which, as intimated heretofore, represents only a stage in the combustion, and the formation of which develops less than one-third of the total possible amount of heat. It is practically impossible to burn anthracite in a furnace without first forming this gas, but it is possible to burn it at once to the higher oxide (CO_2), thus getting the full heating value of the coal, and it is almost a crime not to do so. All that is necessary is to provide for a sufficient influx of air over the fire to furnish the oxygen needed for this second stage of combustion. There are numerous devices on the market, some sold at exorbitantly high prices, intended to be fitted to the fire-door, through which a regulated supply of air is to be allowed to flow and be delivered over the fire-bed, but these are not necessary. Most furnace and stove fire-doors are provided with openings for this purpose, and fitted with wheels or slides by which the inflow of air may be regulated. Some furnaces have a special small door below the fire-door and above the ashpit door,

designed for this purpose. The main thing to guard against is that of allowing too great an inflow of air, in which case the excess of cold air chills the hot gases formed by the fire, lowering the efficiency of the furnace just that much. When the operator can see blue flames emerging from the spaces between the pieces of fuel he may be sure he is burning the carbon monoxide formed by the action of the oxygen of the draft air on the coal within the fire-bed, and is probably getting out of the fuel its maximum heating value—particularly if the blue flames are relatively long. Very short blue flames indicate too great an air supply over the fire. The writer of this paper has seen booklets issued by associations of coal producers or dealers, purporting to instruct users how to get the maximum value out of the coal they use, in which they were instructed always to keep the fire-door tightly closed, except while firing or when it is desired to check the fire. He has wondered whether they really believed what they were saying or whether what they said had any bearing on the fact that they had coal to sell.

In the burning of soft coal, natural gas, artificial gas, gasoline, kerosene and fuel oil, whose constituents are either wholly or partly hydrocarbons, one problem is to so control the air supply that there shall be complete combustion and no formation of soot, which is unconsumed carbon, and which, to the extent that it is produced, represents heating possibilities unrealized. When hydrocarbons burn they seem first to break up, in part at least, into elemental hydrogen and carbon, respectively. The ignition point of a mixture of hydrogen and air is low, so it promptly burns, but the ignition point of carbon (even in a finely divided form) in air is relatively high, and frequently much of that which is formed cools to below its ignition point before it comes into contact with oxygen enough to burn it. Result: smoke or soot, which not only represents fuel lost, but is something which, by coating the heating surfaces of pipes and drums or tubes, makes them poor conductors and prevents them taking up the heat from the gases which are brought into contact with them. It often clogs flues wholly or in part and interferes with the drawing of the heating system. If it gets out into the open air it becomes a nuisance to the neighborhood and seriously disturbs the peace of mind of the housekeeper who likes to see and keep things in a spick and span condition of cleanliness. Housewives compelled to live in communities where soft coal is improperly burned ought to have special consideration shown them in

the Day of Judgment. It is a very vigorous type of religion that will keep one from getting sorely "peeved" when a shower of soot from a neighboring chimney or a passing locomotive stack settles on her beautifully white "wash" on a Monday morning, or any other day of the week, for that matter. Statisticians have figured that the cost of keeping even moderately clean the homes, apparel and persons of individuals living in the smoke-begrimed communities of the country is an enormous one. Physicians tell us that many respiratory troubles are caused by the inhalation of soot, and physicists tell us that the heavy fogs that characterize the atmosphere of many of the world's large manufacturing centers are due to the condensation of gaseous moisture on small particles of soot, instead of its remaining in gaseous form and intimately mixed with the other gases which make up the atmosphere.

In firing with soft coal the furnace fuel bed should not be completely covered over with fresh fuel. If the fire-box is of such shape as to permit it, the fresh fuel should be placed just inside of the fire-door so that the gases promptly liberated will have to pass over a hot part of the fire on their way to the chimney. If a proper supply of air is allowed to mix with them the mixture will ignite and a maximum degree of combustion will be attained, with a maximum amount of heat generated. The same procedure is also good in firing with anthracite. Before adding fresh fuel, the burning coal just inside the fire-door should be pushed back toward the center of the fire-box, or even farther. Frequent firing with small portions of fuel at a time makes for greater efficiency and economy than infrequent firing with larger quantities of fuel.

Correct Air Supply.

Stoves and furnaces are often inefficient because of an insufficient air supply, due to the operator trying to draw all the needed air from a rather tightly closed compartment (cellar, in the case of the furnace, or living room, in the case of the stove). Solid and liquid fuels require for their perfect combustion approximately 15,000 times their own volume of air; and gaseous fuels require from 4 to 10 times their own volume of air. In order, then, that a fire should have the correct amount of air it is necessary to provide fresh supplies of air to take the place of that which goes into the fire chamber.

Occasionally one sees a hot-air heating system in which the air for circulation through the hot-air ducts is also taken from the cellar of the house. Anyone who has ever tried to draw air or water out of a bottle or jug without allowing air to enter can readily understand why it is just as impossible to draw air for either draft or circulation purposes, or both, out of a closed cellar indefinitely. Fresh quantities of air must be supplied, either through special ducts leading to the out-of-doors or else through an open door or window. The open-door or open-window arrangement may appear to be the cheaper, but it has several drawbacks, especially in very cold weather. The entire air space of the cellar becomes chilled, making it decidedly uncomfortable for the furnace tender, and, if the floor above is not thoroughly insulated, making cold the floor surfaces in the rooms immediately above the cellar. The air-duct system is to be preferred, with one duct for fire-draft air and another for circulation air. Each should be fitted with a damper.

Heating Small Rooms.

During the winter season many people heat individual rooms with gas stoves (often without flue connections) or oil stoves, or, occasionally, charcoal stoves, generally without flue connections. When these work properly there is a formation of water vapor in the case of the first two and of carbon dioxide in the case of all three; but in closed rooms, particularly if they are small (such as bedrooms, bathrooms, small offices in warehouses, etc.), the oxygen in the room is soon used up in the combustion of the fuel, the flame gets dim and smoky (in the case of the gas or oil) and, after a while, dies out altogether. In the meantime, what of the person or persons in the room? The oxygen needed for respiration has been used by the fire and there has been put in its place carbon dioxide, at first, and, later, carbon monoxide, a gas which is a deadly poison, even when much diluted with air. Neither of these gases has an odor and neither supports life, so, whether the stove is working properly or not, there is formed a gas or mixture of gases which may cause death, or at least asphyxiation, without any warning whatever.

Persons who have been overcome with carbon dioxide generally recover normal health speedily after having been restored to con-

sciousness, but it is not always possible to revive them. On the other hand, persons who have been overcome with carbon monoxide are often a long time in getting well, if, indeed, they get well at all. Many of them die weeks, sometimes months, afterward because of the blood-poisoning effects of this gas, which, for this reason, is often designated "deadly monoxide gas," especially by newspapers. Every winter there are accidents from the use of oil stoves as sources of heat in unventilated rooms. The writer recalls at this time an incident of his school days. He was using a bathroom which was being heated by a small oil stove and lighted by a small oil lamp. Shortly after entering the room he noticed the light getting dim and smoke issuing from the oil stove. Suspecting the cause, he raised the window an inch or so and promptly both lamp and stove functioned properly. He dreads to think what might have happened to him within the next few minutes, had he not correctly divined the cause of the peculiar behavior of the flame of the lamp just when he did. In his time he has seen two rooms which had been smoked black in just a few minutes from imperfect combustion of kerosene oil, in one case in an oil stove, in the other case in a big oil lamp. In both instances the occupant of the room left it temporarily, closing the door after him, the windows having been previously closed. What each landlady felt, and probably said "under her breath," would not sound well in polite society or look well in print.

Every winter we read in our newspapers accounts of here and there a person being found dead in a room with the gas flowing from a stove or jet where there is no fire. The report usually states that "it is supposed that the victim of the accident bumped against the gas cock and unwittingly turned on the gas, or that he turned the cock too far in turning off the gas." I wonder if the true explanation is not more often this: The victim went to his room, turned on the gas and ignited it. The stove had no flue connection, the room was unventilated, the oxygen was soon burned out of the air and the fire died out, the gas flow, however, was not checked, the victim first became drowsy from lack of oxygen, lost consciousness from the effects of the carbon dioxide and carbon monoxide produced when the gas was burning, and was finally killed by the gas flowing through the open valve. Sometimes we read that the cracks around the windows and doors were found

stuffed with rags or paper, and the immediate conclusion and coroner's verdict is "Suicide," though often nobody can suggest a reason for the person wishing to go into eternity prematurely. I wonder how many times the stuffing of cracks was not done to keep out cold rather than keep in gas. I verily believe that many of these so-called suicides are only victims of their own ignorance.

In every instance where any kind of a stove, whether fitted with flue connections or not, is used to heat a room, provision should be made for an influx of air into the room to take the place of that used in the fire, and particularly so if there is no provision made for carrying the products of combustion to the outside. Experiments have been made at the Pittsburgh station of the United States Bureau of Mines to show to what extent air cracks around windows and doors affect the family coal bill, and dealers in window strips are using the results of these investigations to boost the sale of their wares; but we must not overlook the fact that burning fuels require plenty of oxygen for combustion and human beings require it for their respiration, and the air is the source of this gas. Air we must have. If we have tight joints at doors and windows we must open one or the other; if the windows fit loosely we may often keep them closed, if there is no fire in the room. The cracks may allow enough circulation for respiration and one or two gas lights. To most people the paying of coal bills is preferable to that of paying doctors' and undertakers' bills.

Dampness in the Home.

Flueless gas and oil stoves, when in operation, produce moisture because of the combination of the free and combined hydrogen in the fuel with oxygen from the air. Often a room thus heated resembles the steaming chamber of a Turkish bath establishment. This is particularly true where the fuel is natural gas, as can be stated by those who were among the users of this substance when it first came into general use as a domestic fuel in western Pennsylvania about forty years ago. Because it could be burned without smoke people thought flues an unnecessary expense. In the winter time, when doors and windows were kept closed, the houses became veritable "sweat boxes," the furniture swelled and warped, wallpaper got loose and fell from the ceilings or peeled off the

walls, the windows were covered with sweat or ice most of the time, clothing became damp and uncomfortable, starched articles lost their crispness and often developed mildew, people "caught cold" easily as the result of going out of doors after a season in the water-laden atmosphere of their homes.

Some moisture, the amount varying with the temperature, in the air of living quarters is necessary for our health and comfort, but too much is as bad as too little. The way in which heat and cold affect us is largely dependent upon the percentage of moisture (humidity, we call it) in the atmosphere. Cold, moist air is a good conductor of heat, while cold dry air is a poor conductor. That is why people in the mountainous sections of the State can stand temperatures of fifteen to twenty-five degrees below zero better than we Philadelphians can stand temperatures an equal number of degrees above zero. The dry air of their parts of the country does not carry away their bodily heat as rapidly as does the moisture-laden air of this section.

On the other hand, warm moist air retards evaporation of perspiration and its attendant cooling effect. Moist air at 68 to 70 degrees Fahrenheit seems warmer than dry air at 80. Put a pan of water on or under each radiator and save coal, taking care, however, not to allow the air to become excessively moist. Did you ever notice that persons who have respiratory troubles do a whole lot less coughing in moist air than when the air is dry, and that coughs are less "tight"?

Explosions.

Improper procedure in the ignition of liquid or gaseous fuels may give rise to explosions, and many fatalities have occurred because of ignorance or carelessness on the part of some one or more persons. Gas should not be allowed to flow into a stove unless there is a flame already there and at the point where the gas enters. Gas itself will not explode, as some people imagine, but mixtures of gas and air in a wide range of proportions will explode, hence the importance of not allowing the formation of such mixtures. As poor a mixture as one part of gas to fifteen of air may give rise to violent explosions in the case of some gases.

Gasoline should never be used to hurry a fire, and there would be many fewer graves in our cemeteries if kerosene (so-called "coal

oil") had never been used for that purpose. Gasoline vaporizes at ordinary temperatures and the vapor is highly inflammable. Kerosene does not give off inflammable vapors at ordinary temperatures; in fact one can plunge an ignited match into it without danger. But when used to hurry a fire it is often poured on heated coals which are giving off no flame. The heat vaporizes the kerosene and the mixture of vapors and air often ignites from a glowing coal and with disastrous results.

Kerosene lamp explosions are of decidedly less frequent occurrence than they were in times past, partly because of the increased use of electricity for lighting purposes, but mainly because the kerosene of the present-day market is more nearly free from the low-boiling point fractions which made the old-time product dangerous. Before internal-combustion engines created the big demand for gasoline this substance was a "drug on the market," really a nuisance to the petroleum distiller; and the temptation was to leave as much of it in the kerosene as could be left in and have the product comply with the laws of the several States as regards "fire test." If gasoline always had commanded a higher price than kerosene, as is the case now, there never would have been any reason for establishing a legal "fire test." Since the two have changed places as to price refiners have seen to it that everything that could be used as a gasoline constituent was removed from the kerosene, and today the tendency on the part of many is to leave or put as much kerosene in the gasoline as the mixer "can get away with." Users of oil lamps and oil stoves would do well to bear certain things in mind. The more nearly full the reservoir of the stove or lamp the less the likelihood of the oil getting hot enough to give off inflammable vapors in dangerous quantities. Glass or porcelain bowls are safer than metal, as they are poorer conductors of heat. When a lamp or stove reservoir needs refilling, the flame should first be extinguished, particularly if the reservoir is hot, in which case the space above the oil may be filled with vapors which would ignite easily when driven out by oil flowing in.

Fire Extinguishers.

Thus far we have talked about the production of fire. There come times when we should know how to extinguish fire. The common method is by use of water, which acts chiefly by reducing

the temperature of the combustible below its ignition or kindling point, and also by producing steam, which is not a supporter of combustion. In case of oil fires there is danger of the water "spreading the fire" rather than quenching it. Often, too, more damage results from water than from fire, and other methods of extinction are desirable. Rugs, blankets or other fabrics, particularly when made of wool, are often effective when thrown over the burning material, as they serve to shut off the air supply without which no ordinary fire can go on. Wet or dry earth and sand may often be used, and work in the same way as the blanket—shutting off the air supply. A common dry fire extinguisher consists of a mixture of dry sand and baking soda. The baking soda decomposes when it gets hot in the fire and liberates both water vapor and carbon dioxide gas, neither of which is a supporter of combustion. One type of fire extinguisher uses baking soda in solution, and sulphuric acid, the latter in a separate container so disposed in the apparatus that when the latter is turned bottom-side-up the acid and soda solution mix, producing carbon dioxide gas, which develops the pressure needed to eject the contents of the apparatus through the nozzle of a small hose against the burning material. The effective substances are the water and the carbon dioxide gas, with a little help from the sodium sulphate formed in the reaction within the cylinder.

Carbon tetrachloride is used in one of the popular commercial fire extinguishers. It is very effective, but there are frequent cases where its use results in the production of chlorine, carbon monoxide, hydrochloric acid and sometimes, phosgene, gases, all of which are dangerous to inhale in even small quantities. There is apt to be trouble of this kind when the fire is in an enclosed space, as in a house or garage.

Radiator Paints.

The paint used for decorating the surface of a radiator has a greater effect on its radiating efficiency than most persons might suspect. An elaborate series of experiments conducted in one of the Government laboratories at Washington has demonstrated the fact that those paints which have as their color base a finely divided metal (aluminum, bronze, and so-called "gold" paints) cut down the radiating efficiency of the heating unit more than two-thirds, though

not materially cutting down the total heating effect. Heating units transmit heat in three ways—by *radiation* (in which case heat rays go out in all directions, sidewise as well as upward, and the body which stops these rays becomes warm); by *conduction* (in which case layers of moist air take up heat from the heating surface, pass it on to the next layer, and so on), and by *convection* (in which case layers of air in contact with the heating surface get hot and rise, giving way to other layers which get hot in turn and rise). Ordinarily there is not much heat transmission in a room by conduction. Where there is radiation the air is more evenly heated, and generally only a short time elapses between the time the "heat is turned on" and its effects are noticed. Where there is mainly convection the heated air goes up and, being lighter than colder air, stays up, so that the whole upper strata of air in a room may be excessively hot while the lower strata may be very cold. Obviously, anything that increases radiation in a heating unit is a benefit. Dull black gives the best results, glossy black the next best, dull surfaces of other colors are better than glossy surfaces, and metallic-base paints seem to be the poorest. It is not necessary to remove the aluminum, bronze or gold paint from your radiator. Put the other paint on right over the metallic coat. The experience of a friend of mine may be of interest in this connection. He purchased a house in which the radiators were all painted with aluminum paint, and was told that the previous owner of the house had difficulty in keeping it warm. The new owner's wife did not care particularly for the metallic coloring of the radiators, so she painted them with other colors to harmonize with the other decorations of the respective rooms, using paints which gave dull surfaces. They have never had a particle of difficulty about getting plenty of heat out of the radiators.

When the heat goes up instead of out laterally, air currents are created at or near the floor level, felt as drafts on one's feet and ankles. These air currents gather up dust particles, carry them toward the radiator and, as the air gets hot and rises, the dust also goes up, some of it to lodge on the curtains or wall behind the radiator, some of it to stick to the ceiling above. The darkened places thus formed are responsible for the belief on the part of many housekeepers that steam and hot-water heating systems are dirtier than hot-air systems. As a matter of fact, they cannot bring dirt into a room, but they can and do afford the means by which

it is gathered up and redeposited on more or less restricted areas. Unless the air is filtered, hot-air systems do bring dirt into a house, particularly in thickly populated sections and when the wind is blowing strongly, but it is rather evenly distributed through the house and over the furniture, and its accumulation is not so readily noticed.

Petromortis.

I cannot let the opportunity pass without sounding a strong note of warning as to the danger attendant upon the running of any kind of gas engine or gasoline motor in a confined space (such as a garage with all windows and doors closed) without first having made provision to carry the gases formed in the combustion of the "gas" out of doors. Frequently the "flivver" or "car" develops "motor trouble," and the owner or chauffeur starts it going and begins to tinker with the various parts in an effort to get it to "hit on all cylinders." The day is cold, so he has all doors and windows closed. The burning gas takes oxygen out of the air and pumps into it the same gases as are produced by the hall-bedroom oil stove or gas stove, except that the percentage of carbon monoxide is generally much higher in the exhaust of the engine. Perhaps some member of his family misses him and goes out to the garage to see "why he is so quiet," only to find him unconscious on the floor or in the car. If he is found soon enough he may be revived, but the "deadly monoxide gas" (see newspaper headings) has likely gotten in its work, and complete recovery, if it comes at all, may be only after a long time. If he is not found promptly, the coroner "sits on him" as a victim of what the doctors call petromortis, and somebody else "sits at the steering wheel" of his "machine" in the procession following the hearse which carries him on his last automobile journey on earth. Only a few weeks ago a prominent young lady in a Philadelphia suburb lost her life in just this kind of an accident. The rest of the family were away from home at the time. MORAL: Either leave a window or door open, or attach a hose or pipe to the exhaust of the engine and carry the other end to the out-of-doors; or, better yet, put on your overcoat and run the "bus" out into the yard or street. Better shiver for a short time than be "laid out cold" for all eternity by the "mortician," sometimes called "funeral director," more generally, "undertaker."

THE EXCESSIVE ACIDITY OF THE OFFICIAL SOLUTION OF MAGNESIUM CITRATE.*

By J. W. England.

Last summer some personal friends while in Paris purchased bottles of the French "Purgative Lemonade of Citrate of Magnesia" (the "Limonade Citro-Magnésienne" of the French Codex) at the equivalent cost of only 14 cents each, bottle included, and on coming home were most enthusiastic about its delicious "lemonady" taste and efficient action, claiming that it was markedly superior to the "Citrate of Magnesia" sold in the United States. The French preparation was introduced into medical practice by M. Rogé-Delabarre in 1847 (Dorvault's "L.'Officine," 1898, 592).

It is interesting to note the universality of use of magnesium citrate and its solution. Thus, in addition to the solution of magnesium citrate of the U. S. P., Squire states (Squire's "Companion to the British Pharmacopœia," 1916, 858) that it is recognized by the following foreign pharmacopœias: "Austrian and Hungarian (Potio Magnesiae Citricæ Effervercens); Austrian has also Magnesium Citricum Effervescent; Belgian (Magnesii Citrici Potio); Dutch (Solutio Citratis Magnesici); French (Limonade Citro-Magnésienne); Italian (Citrato di Magnesia Effervescente); Mexican (Solucion de Citrato de Magnesia); Portugal (Limonada Citro-Magnesia); Russian (Potio Magnesii Citrici Aerophora); Spanish (Pocion de Citrato Magnesico Gaseosa); also Pocion de Citrato de Magnesia; German, Japanese, Russian and Swiss (Magnesium Citricum Effervescent). Swiss has also Limonata aerata laxans. Not in the others. French has, also, Citrate de Magnesie desséché."

The U. S. P. solution of magnesium citrate is excessively acid. Each 12-fluid-ounce bottle represents about 150 grains of free citric acid in the form, of course, of acid salt. Lemonade (made by diluting 1½ fluid ounces of lemon juice with sufficient water to make 12 fluid ounces) represents only about 48 to 60 grains of acid or acid salt. It will be seen that our official solution of magnesium citrate represents about 2.5 times as much free citric acid or acid salt as lemonade. For personal use the writer has been adding to each bottle of the official solution about one level teaspoonful (64 grains) of sodium bicarbonate, so as to "cut its excessive

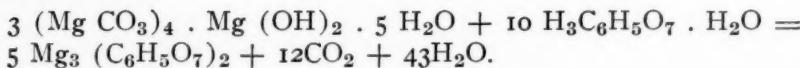
*Presented to the Pennsylvania Pharmaceutical Association, June, 1924.

acidity; this is especially necessary when the solution is to be given to children. When this is done, the free acid of the official solution is reduced about one-third.

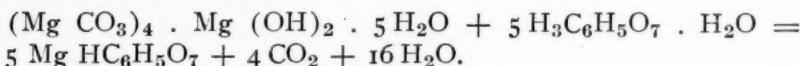
The object of the excessive acidity in the official solution is to obtain a solution of the acid magnesium citrate which is more permanent than the solution of the normal magnesium citrate. But there are reasons for believing that the greater permanency obtained is secured at the sacrifice of acceptability and therapeutic efficiency.

As is well known, when citric acid and magnesium carbonate are decomposed in the presence of water, magnesium citrate is formed and carbon dioxide liberated; the exact composition of the magnesium citrate depending upon the amount of carbonate or acid used.

Normal magnesium citrate has the composition $Mg_3(C_6H_5O_7)_2$ and is but slightly soluble in water, crystallizing from its solution with 14 molecules of water. The reaction in making it is as follows:



The acid magnesium citrate, $MgHC_6H_5O_7$, is very soluble in water and is the compound desired in the official preparation. The reaction in making it is:



"Each molecule of the official magnesium carbonate requires 5 molecules of citric acid to form the acid magnesium citrate. The 15 Gm. of magnesium carbonate ordered in the official formula (for solution of magnesium citrate) require 21.61 Gm. of citric acid to form the normal, or 32.43 Gm. to form the acid salt; the Pharmacopœia orders 33 Gm. of acid, of which a part will be required to decompose the 2.5 Gm. of potassium bicarbonate subsequently added. The official solution must contain, therefore, a mixture of acid and normal salts, the former largely predominating." (N. S. D., 1916, 953.)

Solution of magnesium citrate was first recognized in this country by the U. S. Pharmacopœia of 1850 and it is of interest to trace the various changes that have been made in the formula since that time, as shown by the following table:

SOLUTION OF MAGNESIUM CITRATE.

U. S. P.	Magnesium Carbonate	Citric Acid	Citric Acid Syrup	Potassium Bicarbonate	Water to Make
1850	300 gr. (4 dr. + 1 dr.)	450 gr.	2 fl. oz. (= $7\frac{1}{2}$ gr. Acid)	(Magnesium Carbonate 1 dr.)	Syr. Ac. Cit; C. A. 2 dr.; Oil Lemon, 4 m.; Syrup, 2 pts.
1860	(Magnesium Oxide 120 gr.)	450 gr.	2 fl. oz. (= $7\frac{1}{2}$ gr. Acid)	12 fl. oz.	Syr. Ac. Cit; C. A. 2 dr.; Oil Lemon, 4 m.; Syrup, 2 pts.
1870	200 gr.	400 gr.	2 fl. oz. (= $7\frac{1}{2}$ gr. Acid)	12 fl. oz.	Syr. Ac. Cit; C. A. 2 dr.; Oil Lemon, 4 m.; Syrup, 2 pts.
1880	200 gr.	400 gr.	1200 gr. (9.6 gr. Acid)	12 fl. oz.	Syr. Ac. Cit; C. A. 8; Water, 8; Oil Lemon, 4; Syrup to make 1000.
1890	15 Gm. (= 231.5 gr.)	30 Gm. (= 463 gr.)	60 cc. (= 9.25 gr. Acid)	2.5 Gm. (= 39 gr.)	Syr. Ac. Cit; C. A. 10 Gm.; Water, 10 cc.; Spt. Lemon, ¹ 10 cc.; Syrup to make 1000 cc.
1900	15 Gm. (= 231.5 gr.)	33 Gm. (= 500 gr.)	60 cc. (= 9.25 gr. Acid)	2.5 Gm. (= 39 gr.)	Syr. Ac. Cit; C. A. 10 Gm.; Dist. Water, 10 cc.; Tr. Fresh Lemon Peel (50%) 10 cc.; Syrup to make 1000 cc. Oil Lemon 0.1 mil (= 1.5 m.)
1910	15 Gm. (= 231.5 gr.)	33 Gm. (= 500 gr.)	Syrup 60 mil	2.5 Gm. (39 gr.) or 2.1 Gm. So- dium Bicarb. (= 33 gr.)	350 Mils (11 2/3 fl. oz.) Purified Talc. 5 Gm.
French Codex (1908) ²	20 Gm. (= 308.64 gr.)	32 Gm. (= 493.8 gr.)	Syrup 100 Gm. (75 cc.) (= $2\frac{1}{2}$ fl. oz.)	To carbonate 300 Gm. (= 10 replace 2 Gm. fl. oz.) Total of Mag. Carb. = $12\frac{1}{2}$ fl. oz. with 4 Gm. of Sodium Bi- carbonate	Spt. Lemon (33 1/3%) Oil, with 80 per cent. Alcohol, 1 Gm. (= 0.5 Gm. (5 m.) Oil).

¹ Spt. Lemon, U. S. P. 1890; Oil Lemon, 50 cc.; Fresh Lemon Peel, 50 Gm.; Deod. Alc. to make 1000 cc.² Plain or Carbonated.

The high point in these formulas is the proportions of carbonate and acid used.

In the 1850 formula there was employed 240 grains of magnesium carbonate with 450 grains of citric acid. Sixty grains of magnesium carbonate, additionally, was used to carbonate the solution.

In the 1860 formula 120 grains of magnesium oxide was used, which equals about 300 grains of magnesium carbonate. The proportion of magnesium carbonate to citric acid was, therefore, the same as in 1850—300 to 450 grains per bottle, but potassium bicarbonate was used as the carbonating agent, as in all the later revisions.

In 1870 the proportion of carbonate to acid was as 200 to 400 grains, and it was the same in 1880.

In 1890 a radical change was made in the formula, the carbonate was increased practically 16 per cent. (from 200 to 231.5 grains), and the acid was increased the same percentage (from 400 to 463 grains).

In 1900 the proportion of carbonate to acid was again changed, being made as 231.5 to 509!

In 1910 the 1900 change was retained in the formula and syrup was substituted for syrup of citric acid, decreasing the acidity from 1900 by 0.6 Gm. (9.25 grains).

The most important of these changes has been the great increase of acid in order to secure in the preparation greater permanency, but it is a question, as before stated, whether such a change or series of changes have been for the best. Today, the ratio of carbonate to acid in the formula is as 1 to 2.2. Previously, in the five revisions, it was either as 1 to 2 or 1 to 1.5. The French Codex is only as 1 to 1.6. This authority specifies 20 Gm. of carbonate to 32 Gms. of acid, and on the same basis of carbonate to acid our formula would be 15 Gms. of carbonate to 24 Gms. of acid.

I believe that our formula is unduly acid and should have its acidity reduced by reducing the acid in the formula to 30 Gm. or less and, in addition, the suggestion should be made in the text of the Pharmacopœia, that where there be acid intolerance in the adult, and in the case of children, to whom the solution is to be given, that a level teaspoonful (or more) of sodium bicarbonate should be added to the solution after the bottle has been opened and effervescence has ceased.

A word as to the bicarbonate used to carbonate the solution in the bottle. The Pharmacopœia formerly required the use of potassium bicarbonate only. In the present revision either potassium bicarbonate or sodium bicarbonate is permitted; and it is upon this latter fact that some criticism may be made.

It is not generally recognized that a part—and it is no small part—of the therapeutic value of solution of magnesium citrate is due to the diuretic and diaphoretic action of its alkali citrate—that elimination is to be secured not only by purgation, but also by diuresis and diaphoresis.

Thirty-nine grains of potassium bicarbonate (the official quantity) forms with citric acid about 42 grains of the official potassium citrate, the dose of which is usually only 15 grains.

Thirty-three grains of sodium bicarbonate (the official quantity) forms with citric acid about 39 grains of the official sodium citrate.

Sodium citrate differs in therapeutic action from potassium citrate. "Since it is absorbed with some difficulty, it is a mild purgative, similar in action to magnesium citrate. The portion which may be absorbed will have some diuretic effect. It may be administered where a pleasant saline laxative is required." (Reynold Webb Wilcox, "Materia Medica and Therapeutics," 1917, 391.)

Potassium citrate is rapidly absorbed and is a powerful diuretic. "It is decomposed in the body with the formation of carbonate and exerts an alkaline action after absorption, thus increasing the alkalinity of the blood and of the urine, and of producing free diuresis. It has, also, some diaphoretic action." (Wilcox.)

It would therefore seem desirable to eliminate the alternative use of sodium bicarbonate from the official formula and direct the use of potassium bicarbonate only.

Caution should be expressed under the official formula for solution of magnesium citrate against the use of the so-called "technical magnesium carbonate" for making the official solution, as this product differs from the official, not only in its percentage-yield of magnesium oxide, showing variable composition, but also in containing foreign material.

The next point is that the flavor of the U. S. P. formula is too weak—only about 1.5 minimis of oil of lemon to the 12 fluid ounces of solution.

The formulas for medicated waters contain in 12 fluid ounces about 12 minims of volatile oil, and while it would not be desirable or possible to make the solution of magnesium citrate as of the same volatile oil strength, its oil should be increased, probably to the same strength as that of the French Codex—about 5 minims.

The U. S. P. IX, by heating the solution of magnesium citrate to the boiling point, adding the oil of lemon previously triturated with the purified talc and filtering while hot into sterile bottles, etc., aims to eliminate mould spores or other micro-organisms which are likely to be present in the solution and cause conervoid growths, but it is a question whether *complete* sterilization is effected by the method specified, although it does retard the formation of fungoid growth and makes for greater permanency of the solution.

Before filtering always wash the filtering paper in the funnel with boiled water, as filtering paper kept in stock is very apt to absorb drug odors and give a druggy taste to the filtrate.

HELIUM AND OTHER RARE GASES.*

Edward J. Hughes.

The air that we take into our lungs consists of about 78 per cent. nitrogen and 21 per cent. oxygen. In the remaining 1 per cent. there has been found, within the last thirty years, a group of rare and inert gases. These rare gases have been separated and studied and a few of them have already become useful and valued products. The names of these gases are, argon meaning inert because of its chemical inactivity; neon from the Greek word meaning new; krypton which means the hidden element; helium from helios, meaning the sun; and xenon which signifies the stranger.

Argon is one of the most efficient available gases for filling incandescent light bulbs because it has a very low thermal or heat conductivity, it is absolutely inert, and has a density that holds in check the escape of the particles of the tungsten filament.

An interesting and useful spark plug tester now on the market contains a tube filled with neon and is serviceable in locating ignition troubles in an automobile. The tester is applied to the spark

*Broadcast under the auspices of the Philadelphia College of Pharmacy and Science through the station of Gimbel Brothers in Philadelphia.

plug and the state of the current is recorded by the depth of the rose-colored light which appears at once in the tiny cylinder.

Nearly everyone is familiar with the spectacular use of helium for inflating airships. The remarkable increase in the availability of this element from sources other than the atmosphere has done much to stimulate both scientific and popular interest and it is to the consideration of helium that most of this talk will be devoted.

During the World War a great many lives were lost and valuable property destroyed by the explosion of airships and balloons in midair. These air-going vessels were inflated with hydrogen, an inflammable gas. When the hydrogen became ignited an explosion usually resulted with loss of life. The need of the nations was for a light, non-inflammable gas that could be used in place of hydrogen. When the war ended this need had not been successfully met.

Since the close of the war tragedy has continued to follow the movements of the hydrogen-filled aircraft, striking every now and then and exacting its heavy toll of human life. Three well-known disasters have occurred within the past three years. In August, of 1921, the airship ZR-2 broke and fell in flames at Hull, England, with a death toll of forty-two. In February, of 1922, the airship Roma fell a burning wreck at Hampton Roads and thirty-four more lives were lost. The Dixmude, a French dirigible that held the world's record for endurance and distance, disappeared late in December of 1923 and a few days later the body of her commander was found off the coast of Sicily. The French authorities held that this ship had exploded and fallen into the Mediterranean with fifty-two people on board.

The demand for a substitute for hydrogen stimulated research and during the war various nations had experts investigating the possibility of practical sources of helium, which, although rare at the time, was known to be a very light, non-inflammable gas. The results of these investigations showed that the only practical source of helium, where the gas could be produced on a large scale, was found within the United States. When the armistice was signed the United States had 147,00 cubic feet of helium on the dock awaiting shipment to the battlefields of Europe. In the summer of 1923 the newly-built American airship ZRV-I, since named the Shenandoah, was filled with helium and created a stir by completing a successful flight from Lakehurst to St. Louis. Up to the present

time the Shenandoah has undergone a number of test flights and has successfully withstood a terrific gale and storm while in the air without injury to a single member of the crew. One can watch the Shenandoah flying majestically through the skies with the assurance that there is no danger of the enclosed helium exploding or catching fire. The United States Government is planning to send the Shenandoah on a flight over the polar regions and already commercial air routes are being planned between the larger cities of this country and between the United States and foreign countries.

In view of these facts and of the successful commercial production of helium during the last few years it would seem that if dirigibles are to continue their conquest of the air hydrogen had better be discarded.

In 1868, while observing an eclipse of the sun by the use of the spectroscope, Janssen and Lockyer noted a yellow line in the spectrum. This behavior failed to correspond with that of any other substance which had thus far been examined. It was concluded that this line was due to an element unknown upon the earth and the name helium was given by Lockyer, from helios, meaning the sun.

In 1889, Hillebrand, an American mineralogist, found an inert gas evolved from a certain mineral and assumed that this was nitrogen. Sir William Ramsay made similar observations upon heating this mineral in 1894. In 1895, twenty-seven years after the original discovery, Kayser announced the discovery of helium in the atmosphere. The finding of helium in the air was largely the result of carefully following up inconsistencies that existed between the properties of nitrogen obtained from the air and nitrogen obtained from other sources. So perplexed was Ramsay at one time in his spectroscopic examination of atmospheric nitrogen that he mechanically wiped off the lens of his instrument hoping to remove the source of his confusion.

A striking observation was made in 1903 when it was found that if radium emanation is confined for a few days it disappears and helium appears in its place. This discovery, which represents the first known production of one element from another, seemed to be a realization of the dreams of the alchemists. A little later on it was proved that certain rays emitted by radium emanation consisted of electrically charged helium atoms.

The discovery which was destined to make helium a typical American resource was made by Cady and McFarland in 1907 when they reported the presence of helium in a number of natural gases, mainly from Kansas. Helium has also been found, in smaller quantities, in some of the natural gases of Canada, in the waters of certain mineral springs and is given off from the radioactive minerals.

Next to hydrogen helium is the lightest substance known. It is extremely difficult to liquefy and is the only gas that has not been frozen. It is without color and odor. It is a very diffusible gas and yet not as much so as hydrogen, which means that helium does not escape through a membrane as rapidly as hydrogen does. Chemically helium is very obstinate, having resisted all sorts of efforts to make it combine or react with other materials. This seems to explain the property that gives to helium perhaps its greatest value, namely, its non-combustibility. It must be noted that while helium is twice as heavy as hydrogen it is still so very much lighter than air that its lifting power in air is almost as great as that of hydrogen.

Helium has become one of our greatest national assets since the United States practically controls the world's output. Before the war there were probably ten or fifteen cubic feet of helium in existence. This was owned by a professor named Onnes who successfully liquefied helium and was used by him in making low temperature investigations. The cost of helium at that time was more than \$1000 for each cubic foot. Dr. R. B. Moore, formerly chief chemist of the United States Bureau of Mines, stated in an address delivered in Philadelphia last November that experimentation for war purposes has shown how it can be made for ten cents a cubic foot and that at the present time it can be made for four cents for each cubic foot. The richest sources of helium are from the natural gases of Texas, Oklahoma and Kansas, where the helium is present, in some instances, in quantities up to between one and two per cent. of the natural gas. The U. S. Government operated three experimental plants during the latter part of the war and up to December 1, 1921, there had been produced in the experimental work of the Government 2,300,000 cubic feet of helium almost pure.

Helium is present in the atmosphere only to the extent of about one volume in 185,000 volumes of air so that the commercial extraction of helium from this source is not practicable.

Helium is extracted from natural gas by the application of cold and pressure. The other constituent gases are liquefied whereas the helium remains as a gas and is removed as such. The natural gas after passing through a compressor plant becomes a better illuminating gas than before and can be returned to the gas company for commercial use.

Notwithstanding the decreased cost of helium every effort is being made to avoid wasting this valuable gas. Whether hydrogen or helium be used to fill the envelope of an airship there is always a certain amount of the gas lost by diffusion into the air while air gradually filters in diluting the gas and reducing its lifting power. Instead of being wasted this gas is carefully purified or reprocessed.

One of the objections to the helium-filled airship has been the necessity of valving or releasing a quantity of the gas in order to make a landing. By the time a ship has gone a thousand miles it has used up two or three tons of gasoline making it so light that in order to land some of the gas had to be wasted. An interesting device has been perfected to offset this objection which involves the condensation of the water vapor formed by the burning of the gasoline in air. The water recovered by this method and stored on the ship has been found sufficient to compensate the loss of weight through the consumption of fuel.

With the only large source of natural gas containing helium within its borders the United States is awakening to the fact that it is in possession of a monopoly that ought to be retained from the standpoint of national defense. To this end Representative Kahn of California has introduced a bill in Congress authorizing the conservation, production and exploitation of helium gas, a mineral resource, pertaining to the national defense. Upon the recommendation of the Secretary of the Interior, President Coolidge has recently created the country's first helium reserve, setting aside 7100 acres of gas lands in eastern Utah. The land will be known as helium reserve No. 1 and will be closed to public settlement, location, sale or entry.

It is difficult to imagine at this time how vast the influence of helium may be upon the world of the future. It is entirely probable that helium will enable the Shenandoah, in its proposed flight to the north polar regions, to succeed in mapping out thousands of miles of territory never explored by man, or to establish the prac-

ticability of a trans-polar air route from western Europe to Japan over the top of the world.

The connection of helium with the study of radio-activity is becoming increasingly interesting. Helium is especially useful to science in carrying out investigations that involve extremely low temperatures. It has been suggested that helium be supplied to deep sea divers, along with oxygen, since it enables the diver to remain submerged for a longer period. When this use for helium goes into practice it can be truly said that an element known to the world for less than three score years has already aided man in exploring the depths and surmounting the heights of the earth.

A PARADISE FOUND.

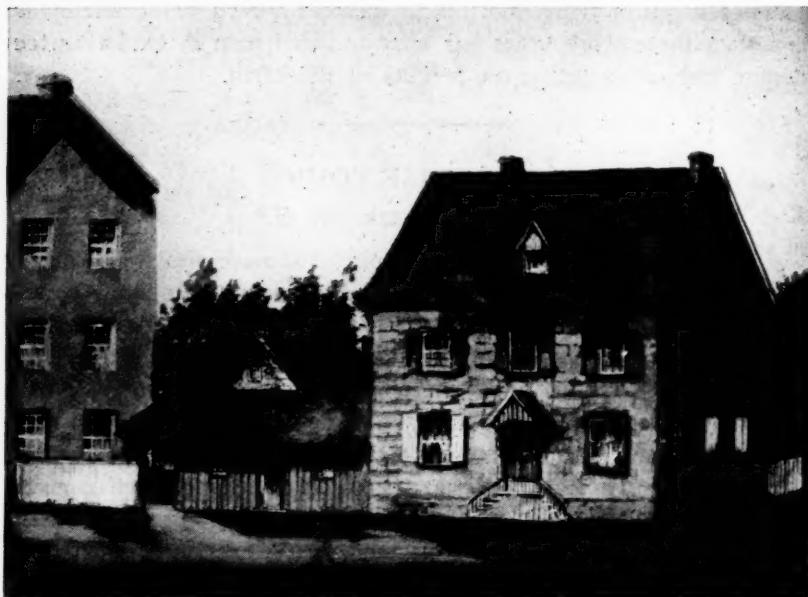
W. J. Stoneback, Ph. G.*

While attending the Pennsylvania Pharmaceutical Association Convention it was my great pleasure to visit one of the many points of interest, in reality the Garden Spot of Bethlehem, Pa. Bethlehem may proudly boast and justly so of her musical achievements, her steel industry, her university, her schools, her hospitality and her numerous other achievements but she has unconsciously contributed an everlasting monument to American pharmacy in that the oldest pharmacy in America is situated on Main Street opposite the Hotel Bethlehem.

During the first decade of the town's existence drugs and medicinal preparations were contained in a room in the house of the little Steeple on Church Street. The room was called "Die Apothke," in charge of Dr. Frederick Otto, and after 1750 of his brother, Dr. J. Mathew Otto. "That the stock in trade of the apothecary of those days consisted more of simples than the fashions of modern practice demands, may be inferred from the fact that the dispenser of the drugs had under his care an extensive Botanic Garden in the rear of the Single Brethren's house, where he cultivated medicinal exotics; an evident proof of this is the occasional discovery of a few of the more hardy plants which have survived to this day and linger in some of the sequestered nooks in these grounds."

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A dwelling, a one-storied stone drug store and a frame laboratory were built for the apothecary and occupied by him in July, 1752; a second story of frame filled with brick was added in 1764. Because of his duties as a physician and surgeon, a resident apothecary was necessary, which position Timothy Horsefield, Jr., filled ably for twenty-eight years from 1761 until his death on April 11, 1789.



Buildings as they appeared when Simon Rau entered the store as an apprentice under Dr. Freytag. The copy was made by E. A. Rau from a water color sketched by Carl Wallmuth. The original is 12 by 20 inches and may be seen in store of Simon Rau & Co., in Bethlehem, Pa.

Dr. J. Eberhard Freytag took charge of the store on his arrival in Bethlehem in January of 1790. He purchased the stock and fixtures from the Moravian Congregation in 1796, carrying on the business on his own account for forty-three years.

The next owner was Simon Rau, who had been under Dr. Freytag's tuition since 1830. The venerable pile, dwelling, store and laboratory was razed by Mr. Rau in 1862-3 and replaced by the more commodius dwelling and store buildings now occupying the same site. In 1866 he associated with him in the drug business

his brother David. This partnership continued until January, 1879, when David Rau died.

After his death the business was conducted by Eugene A. Rau and Robert Rau, cousins, under the firm name of Simon Rau & Company. Mr. E. A. Rau relinquished his business connections in 1913, the store now being under the control and ownership of Bachman and Smith.

A fact of which not many are cognizant even in Bethlehem is that the retired member of the firm has today and has had since 1888 one of the most complete Botanical Gardens under cultivation in this part of the country—a veritable Eden. No efforts have been spared to make this the most attractive spot in that many native medicinal, exotic and ornamental plants are to be found here.

On Saturday afternoon, June 21, 1924, the writer and his wife made a pilgrimage to the home of Mr. Eugene Rau. Here we were received by a man who, although he has passed the proverbial three score years and ten-plus is hale, hardy and alert, having borne the vicissitudes of life without a visible scar. Although Mr. Rau lost his helpmate through death about a year ago he has borne his loss bravely and has not lost the incentive love of nature which was so thoroughly imbued in him by his estimable mother and father. Throughout his entire career the high ideals of pharmacy and a desire to grow and to collect plants were the inspirations to greater endeavors. This led him to travel in foreign countries more than once, evidences of which may be seen in his garden. In 1880 he in conjunction with Mr. A. B. Hervey, of Taunton, Mass., catalogued the *Musci* or *Mosses* of North America, a work which readily supplied a long-felt want of American botanists. In this catalogue all the authentic species and varieties reported from Mexico to the arctic regions have been included and their habitat given with as wide a range as the examination of references and reliable herbaria would permit.

After discussing the many phases of usefulness of botanical plants or plant parts to the pharmacist of today (for we must remember that pharmacy owes its origin to the ancient herbalists and later plant researchers), we were ushered into the garden. It was hard indeed to find a place to start in the description of the plants which have responded to the kindly care of Mr. Rau and which have developed into maturity year after year.

Probably the one which would receive the most attention at a casual glance is a hardy specimen of *Rheum officinalis*, L. secured in Hernhut, Germany, on one of his trips abroad just before the World War. The rhizome and roots were planted on his return and each year since a copious growth of leaves and flowering scape have been produced. This year the scape attained a height of nine feet. Among the large number of plants a few deserve special mention, such as, the *Cactus* species, *Euonymus atropurpureus* (in flower at present), a Siberian Pea-tree, *Digitalis purpurea*, *Atropa Belladonna*, a Grape-fruit tree (five feet tall, raised from seed), a Otaheite-Orange tree, *Euphorbia splendens*, *Sarracenia purpurea*, *Waldmeister* and *Tarragon*. Neatly arranged throughout the entire yard and garden are Rose bushes of almost every cultivated variety, bearing flowers the colors of which an artist would find hard to imitate. Peonies of every hue surround the house. Shade trees lend their shapely graces to the surrounding atmosphere. The entire setting is made the more attractive by the presence of a small pool in front of the garden in which Japanese Fantails swim leisurely about.

It would be impossible to describe all the plants noted at this time. To illustrate the success any one may obtain in developing a botanic garden, I have summarized 104 plants (out of the vast number grown), under their respective families together with their synonyms where known which Mr. Eugene A. Rau has successfully grown in his garden at Church and Center Streets in Bethlehem, Pennsylvania.

(1) *Aceraceae*

1. *Acer Negundo*, L. (Box Elder.)

(2) *Apocynaceae*

2. *Vinca minor*, L. (Common Periwinkle, "Myrtle.")

(3) *Araceae*

3. *Acorus Calamus*, L. (Sweet Flag, Calamus.)

4. *Arisaema Draconitum*, (L) Schatt. (Green Dragon, Dragon Root.)

5. *Arisaema triphyllum*, (L) Schatt. (Indian Turnip, Jack-in-the-pulpit.)

6. *Arum italicum*, Mill.

7. *Arum traguntia*, L.

(4) *Araliaceae*

8. *Aralia spinosa*, L. (Angelica-Tree, Hercules' Club.)

- (5) Aristolochiaceae
 - 9. *Asarum canadense*, L. (Canada Snakeroot, Wild Ginger.)
- (6) Berberidaceae
 - 10. *Podophyllum peltatum*, L. (May Apple, Vegetable Mercury.)
 - 11. *Berberis vulgaris*, L. (Common Barberry.)
- (7) Cactaceae
 - 12. *Cereus grandiflorus*,
 - 13. *Cereus triangularis*,
 - 14. *Phyllocactus species*,
 - 15. *Rhipsalis salicarnoides*.
- (8) Cannaceae
 - 16. *Canna indica*, (Indian Shot.)
- (9) Caprifoliaceae
 - 17. *Sympocarpus racemosus*, Michx. (Snowberry.)
- (10) Caryophyllaceae
 - 18. *Cerastium tomentosum*, L. (Mouse-ear, Chickweed.)
 - 19. *Saponaria ocymoides*, L.
- (11) Celastraceae
 - 20. *Euonymus atropurpureus*, Jacq. (Burning Bush, Wahoo.)
 - 21. *Euonymus obovatus*, Nutt.
- (12) Commelinaceae
 - 22. *Tradescantia virginiana*, L. (Spiderwort.)
- (13) Compositae
 - 23. *Artemisia Abrotanum*, L. (Southernwood.)
 - 24. *Artemisia dracunculus*, L. (Tarragon.)
 - 25. *Aster novae-angliae*, L.
 - 26. *Erigeron philadelphicus*, L. (Fleabane.)
 - 27. *Inula Helenium*, L. (Elecampane.)
 - 28. *Leontodon species*.
 - 29. *Pyrethrum roseum*, L. (Insect Flowers.)
 - 30. *Rudbeckia hirta*, L. (Yellow Daisy, Black-eyed Susan, Nigger-head.)
 - 31. *Senecio aureus*, L.
 - 32. *Tanacetum vulgare*, L. (Common Tansy.)
 - 33. *Tussilago Farfara*, L. (Coltsfoot.)
- (14) Convallariaceae
 - 34. *Aspidistra lurida*, L.

- (15) Cornaceae
 - 35. *Aucuba japonica*.
- (16) Crassulaceae
 - 36. *Bryophyllum pinnatum*.
 - 37. *Sedum acre*, L. (Mossy Sedum.)
 - 38. *Sedum telephioides*, Michx.
 - 39. *Sempervirum tectorum*, L. (Hen and Chickens.)
- (17) Cruciferae
 - 40. *Hesperis matronalis*, L. (Sweet Rocket, Dame's Violet.)
- (18) Euphorbiaceae
 - 41. *Euphorbia lactea*, Roxb.
 - 42. *Euphorbia splendens*.
 - 43. *Ricinus communis*, L. (Castor Oil Plant.)
- (19) Fumariaceae
 - 44. *Dicentra formosum*, L.
- (20) Geraniaceae
 - 45. *Geranium armenum*.
 - 46. *Geranium Balkanum*. (Fragrant Geranium.)
 - 47. *Geranium maculatum*, L. (Wild Cranesbill.)
 - 48. *Geranium Robertianum*, L. (Herb Robert, Red Robin.)
- (21) Hydrophyllaceae
 - 49. *Hydrophyllum canadense*, L. (Water Leaf.)
- (22) Iridaceae
 - 50. *Iris florentina*, L. (Orris Plant.)
 - 51. *Iris pseudacorus*, L. (Yellow Iris.)
- (23) Labiate
 - 52. *Lamium rugosum*, L. (Dead Nettle.)
 - 53. *Lavandula spicata*, L. (Lavander.)
 - 54. *Mentha piperita*, L. (Peppermint.)
 - 55. *Monardo didyma*, L. (Oswego Tea, Bee Balm.)
 - 56. *Monardo fistulosa*, L. (Wild Bergamot.)
 - 57. *Rosmarinus officinalis*, L. (Rosemary.)
 - 58. *Salvia officinalis*, L. (Garden Sage.)
- (24) Leguminosae
 - 59. *Apia tuberosa*, Moench. (Ground Nut, Wild Bean.)
 - 60. *Caragana aborescens*, L. (Siberian Pea-tree.)

(25) Liliaceae

61. *Atamosco candida*, L. (Peruvian Lily.)
62. *Colchicum autumnale*, L. (Meadow Saffron.)
63. *Lilium album*, L. (White Lily.)
64. *Ornithogalum caudatum*, L. (Larger Star-of-Beth-lehem.)
65. *Uvularia grandiflora*, Sm. (Bellwort.)
66. *Veratrum viride*, L. (Green Hellebore.)
67. *Yucca filamentosa*, L. (Adam's Needle.)

(26) Lobeliaceae

68. *Lobelia cardinalis*, L. (Cardinal-flower.)
69. *Lobelia siphilitica*, L. (Great Lobelia.)

(27) Loganiaceae

70. *Spigelia marilandica*, L. (Indian Pink.)

(28) Magnoliaceae

71. *Liriodendron Tulipifera*, L. (Poplar or White Wood.)

(29) Malvaceae

72. *Althaea officinalis*, L. (Marsh-Mallow.)

(30) Marantaceae

73. *Maranta zebrina*.

(31) Oleaceae

74. *Forsythia suspensa*.

(32) Orchidaceae

75. *Cypripedium hirsutum*, (Mill.) (*C. spectabilis*, Salisb.). (Showy Lady-slipper.)

76. *Cypripedium parviflorum*, Salsb. (Smaller Yellow Lady-slipper.)

77. *Cypripedium parviflorum* var. *pubescens*, (Willd) Knight. (Larger Yellow Lady-slipper, Moccasin Flower.)

(33) Papaveraceae

78. *Papaver orientale*, L. (Oriental Poppy.)

79. *Sanguinaria canadensis*, L. (Blood-root.)

80. *Stylophorum diphyllum*, (Michx.) Nutt. (Celandine Poppy.)

(34) Passifloraceae

81. *Passiflora incarnata*, L. (Passion Flower.)

(35) Polygonaceae

82. *Rheum officinalis*, L. (Medicinal Rhubarb.)

- (36) Polemoniaceae
83. *Phlox paniculata*, L. (Garden Phlox.)
- (37) Polypodiaceae
84. *Davallia* species. (Fern Ball.)
- (38) Primulaceae
85. *Primula veris*, L.
- (39) Ranunculaceae
86. *Aconitum napellus*, L. (Monkshood, Friar's Cap.)
87. *Aquilegia canadensis*, L. (Wild Columbine.)
88. *Helleborus niger*, L. (Black Hellebore.)
89. *Zanthoriza apifolia*, L'Her. (Shrub Yellow-root.)
- (40) Resedaceae
90. *Reseda* (hybrid). (Mignonette, Dyer's Rocket.)
- (41) Rhamnaceae
91. *Rhamnus cathartica*, L. (Common Buckthorn.)
- (42) Rosaceae
92. *Prunus triloba*. (From China.)
- (43) Rubiaceae
93. *Asperula odorata*, L. (Waldmeister.)
- (44) Rutaceae
94. *Citrus grandis*. (Grape-fruit Tree.)
95. Otaheit-Orange.
- (45) Sarraceniaceae
96. *Saracenia purpurea*, L. (Side-saddle Flower, Pitcher Plant, Huntsmann's Cup.)
- (46) Saxifragaceae
97. *Boykinia Japonica*, Nutt.
98. *Hydrangea arborescens*, L. (Wild Hydrangea.)
- (47) Scrophulariaceae
99. *Digitalis purpurea*, L. (Fox Glove, Folks' Glove, Dead Men's Bells.)
100. *Penstatum digitalis*.
101. *Veronica virginica*, Nutt. (Culver's Physic.)
- (48) Solanaceae
102. *Atropa Belladonna*, L. (Deadly Nightshade, Ground Wild Cherry.)
- (49) Umbelliferae
103. *Osmorhiza* species.
- (50) Valerianaceae
104. *Valeriana officinalis*, L. (Garden Heliotrope.)

AIMS AND DEVELOPMENT OF THE PHARMACOGNOSY LABORATORY SOUTH DAKOTA STATE COLLEGE DIVISION OF PHARMACY.

Anton Hogstad, Jr., P. C., M. S.

Introduction.

In connection with the reorganization of the South Dakota State College Division of Pharmacy, which has been in course of progress for the past six or seven years, the writer was accorded that unusual privilege of initiating and developing a modern pharmacognosy laboratory, the Medicinal and Poisonous Plant Investigations Gardens as well as the preparation of courses of study for Pharmaceutical Botany (Pharmacognosy I), Phyto- and Micro-Chemistry (Pharmacognosy II), the general course in Pharmacognosy (Pharmacognosy III) and that of *Materia Medica*.

It is the purpose of this paper to review some of the salient facts relative to the growth and development of this work and to set forth the general policy of the work in relation to the aim and scope of same.

Aims and Scope.

Although the task of equipping the pharmacognosy laboratory has now been completed for a period of some two years, and the gardens are now entering upon their seventh season, the general policy as to the instructional work as set forth in this paper, is still passing through the experimental and critical era, for it has been found to be an exceedingly difficult problem to adapt a course, such as Pharmacognosy, with its many ramifications, to the general pharmaceutical curriculum. This has been found to be especially true in the endeavor to make the work as applicable as possible to the needs of the present day, without destroying the essential characteristics of the subject, by eliminating in whole or in part, what might be termed nonessentials, and to emphasize those features of the work which will be of greatest value and benefit to the student of today, the retail pharmacist of tomorrow.

One of the outstanding thoughts which has been projected into the work throughout, and which the writer deems very essential, has been that of recognizing the importance of chemical and micro-chemical studies in relation to the subject of Pharmacognosy. This

thought, as will be shown later, has entered materially into the plans of the modern pharmacognosy laboratory, as well as the modern pharmaceutical research laboratory now being installed.

The first step in this direction, which was taken some seven years ago, was to rescue, with the permission of the head of the Department of Botany, the courses in Pharmaceutical Botany and Pharmacognosy, which were then being offered by the Department of Botany, and to have them transferred to the Division of Pharmacy. The writer upon assuming his duties at the South Dakota State College in the fall of 1917, noted that the work which was being offered by the Department of Botany, was wholly inadequate for the needs of the pharmacy students. The work had been presented by a group of botanists, who, not being trained along pharmacognostical lines, were unable to place the proper interpretation upon the work. One cannot blame the Department of Botany for this condition of affairs, but rather ourselves, for many of those engaged in pharmaceutical teaching consider that the courses in Pharmaceutical Botany and Pharmacognosy, to be essentially of a botanical nature. This condition of affairs is very common throughout our schools and colleges of Pharmacy, the result being that the work in Pharmacognosy is seriously handicapped.

The second step was to reorganize the course, so commonly designated as Pharmaceutical Botany, to include instruction in phyto- and micro-chemistry, with pharmacognostical interpretations.

This status of affairs is interestingly stressed by Wirth in an editorial entitled "Pharmacognosy, Today and Tomorrow,"* in which he calls attention to the need for the introduction of chemical principles in pharmacognostical studies. Wirth states that 95 per cent. of purely pharmacognostical training (excluding *Materia Medica*), is devoted to morphology and histology. No attempt was made by Wirth to define the term *Materia Medica* as to what same embraces, but nevertheless the significant fact remains, that too much emphasis is placed upon the botanical phase of pharmacognostical studies, to the detriment, and in some cases to the utter neglect of the other important subdivision of the work, namely, that of phyto- and micro-chemistry.

The writer does not wish to be interpreted as belittling in any sense whatever, the legitimacy and importance of morphological and histological studies as a part of pharmacognosy, for they are both

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essential and important subdivisions. He simply wishes to point out the need for instruction in the other phase, and by so doing to bring about a balanced condition and happy combination of affairs.

Surely one cannot attempt to conduct extensive pharmacognostical investigations without taking into consideration the underlying chemical principles involved, for the vast subject of drug plant constituents, *e. g.*, alkaloids, glucosides, tannins, resins, gums, balsams, etc., is simply nothing more or less than a vast and complex chemical study. One cannot expect a botanist to conduct investigations of this kind, except that they have had special training in this particular field of investigation. One but needs look to the work in photosynthesis where a similar condition of affairs prevailed for more than 100 years. Photosynthetic studies of the past had always been considered to be a problem for the botanists, so accordingly the work was sent into botanical channels, where it remained dormant, or practically so, for 100 years or more. We may ask the question, why? Simply that photosynthetic studies again are based upon chemical principles, and not until the phyto-chemist entered the field was any real progress noted.

Then again, on the other hand, the question of drug action and therapeutics, prescription incompatibility, etc., are in large part problems involving chemical study. The former, that of drug action and therapeutics, as a chemical study, is so well exemplified, in the light of modern research dealing with that vast subject of chemical pharmacology. This fertile field of investigation, which has hardly been touched upon as yet, but which has already sounded the keynote for rational therapeutics, is primarily one of a chemical nature, probably better expressed as a bio-chemical study.

With the above thoughts in mind, the work which had been offered under the title of Pharmaceutical Botany, was reorganized to include instruction in phyto- and micro-chemistry in addition to the morphological and histological studies.

According to the new three-year plan, the first work of a pharmacognostical nature, will be that of the course in morphology and histology offered during the third quarter of the Freshman year. This course will extend over the entire quarter, and which begins with the consideration of the cell, in regard to the nature and function of same. This is then followed by a detailed study of the various types of cells and tissues. Next follows a morphological and histological study of various types of plant organs, using

as examples drug materials in so far as is possible. The last portion of the work deals with the examination of powdered typical plant organs, not so much for the purpose of specific pharmacognostical identification of the material, but rather to acquaint the student with the various types of tissues to be expected in that particular type of powdered drug plant organ.

Pharmacognosy II, that of the course in phyto- and micro-chemistry, begins as in the case of Pharmacognosy I, with a consideration of the cell, but this time from a chemical viewpoint. The



- (1) The modern pharmacognosy laboratory showing various quaint herbs, wall map (at extreme left), Leitz Edinger photomicrographic, projection and drawing apparatus, special type pharmacognosy desks with hand-type drug distributing boxes, reagents, microscope and microchemical equipment.
- (2) Garden of many herbs—the medicinal and poisonous plant investigations gardens. Showing pergola entrance with Cascara trees on both sides. Bed of Conium maculatum in immediate foreground.
- (3) *Rheum officinale*. From collection of drug plant photographs of medicinal and poisonous plant investigations gardens.

protoplasmic cell contents are studied, at which time considerable emphasis is placed upon photosynthetic studies, to show the relationship of this marvelous work of Nature to our daily life. This work naturally leads into the examinations of the various starches and dextrans, and then continues through some twenty-five non-protoplasmic cell contents. This work is not merely a textbook proposition, but the students actually test for, isolate, and purify, etc., the various drug plant constituents. The more common tests receive considerable consideration, especially those of the U. S. P. IX. The subject of prescription incompatibilities receives its first

consideration at this point, which has proven to be of material value when they enter upon the study of prescription incompatibilities.

Departments as a rule are too prone to stay within their own field of endeavor and fail to show the relationship of the work in progress, to the future work. The special applications of starch, crystal, etc., studies receive special attention at this point, in relation to adulterations and substitutions. This course is offered during the first quarter of the Sophomore year and extends over the period of the one quarter.

This is then followed by the regular course in Pharmacognosy, designated by the writer as Pharmacognosy III. This course consists of a detailed study of 100-150 crude vegetable and animal drugs. The remainder of the long and questionable list of crude drugs are taught simply as to titles, definitions, constituents, general usage, etc., in which considerable attention is devoted to synonymy and identification. The drugs that receive special attention are studied by having the student prepare drug monographs, the outline of which in brief is as follows:

1. Latin Title.
2. English Title.
3. Synonyms.
4. Definition.
5. Derivations: titles, botanical origins and family names.
6. Habitat.
7. Methods of collection, preparation, preservation, etc.
8. Macroscopical description with drawings.
9. Microscopical description with drawings.
10. Constituents, with tests and demonstrations.
11. Examination of powdered drug material.
12. Adulterations, substitutions, etc.
13. Diagnostical features for identification purposes.
14. General action and therapeutics.
15. Miscellaneous.

Special emphasis is placed upon the correct spelling and pronunciation of titles and botanical origins. There is evidently much work to be done by pharmaceutical educators when it comes to the problem of correct pronunciation, for it is very apparent that this part of the profession has been sadly neglected.

Habitat study has received a new lease on life, by getting away from the usual cut and dried textbook method, which has been accomplished by a series of wall maps (behind glass). The maps are those as supplied by the National Geographic Society. The general procedure is to have the student step to the maps and to locate the countries from which the drugs are derived. By the introduction of this innovation a great deal of interest has been aroused and which quite often leads to considerable argumentation. It brings to their minds recollections of former incidents back in their grammar school days and also politely informs them that they are a bit "rusty" on their geography. This order of events is reversed at times, by naming the country and to have the student state what drugs are derived from that country. The students are also required to prepare sets of maps, by filling in the names of the drugs on a series of blank maps, which shows them at a glance the drugs derived from that country.

Derivation studies were introduced in order to deviate, if possible, from the hum-drum of memorizing hundreds of words that mean nothing to them, except long words that are difficult to pronounce. Of course one cannot hold a student responsible for all derivations, but the student is required to possess a good working knowledge of the derivations of at least the ones in common usage. It may be said at this point, that work of this kind has been introduced into the course, in an attempt, if possible, to humanize and to make interesting what the students so often term a dry subject.

The writer has made no attempt whatsoever to neglect the work in morphology and histology for the sake of phyto- and micro-chemistry, but on the other hand, has attempted to make a combination study of same. In this general course, histological studies are primarily conducted for the purpose of noting the presence of this or that constituent. In this connection the writer has in mind such histological studies as sections of ginger for the presence of volatile oil and resin, sections of oak bark for tannin studies, and sections of elm bark for mucilage studies. The work along histological lines for identification purposes is also presented, but not over-emphasized, as there is but little connection between a "mere transverse section" and the prescription counter. The work in histology and morphology is greatly facilitated by employing the set of permanent slides, drug plant photographs and the photomicrographic series.

With the facilities as are now offered by the special type of modern pharmacognosy desk, the work on drug plant constituents has been completely reorganized from the former textbook method of presentation to that of actual laboratory investigation. Each student is provided with micro-chemical equipment in addition to the usual microscopical accessories, and also has access to the general cabinet of chemical and micro-chemical apparatus. The studies on constituents, of course, is necessarily a continuation of Pharmacognosy II, but more detailed in nature, and with a specific purpose in view, as to the drug in question, and not as a group study. The greater portion of this work is done by the students, either individually or in groups of two or three. The students set up their own apparatus and conduct their own demonstrations. The following represent a few of the list of tests and demonstrations as conducted by the students during the past year:

1. Preparation and testing of mucilages of Chondrus and Agar.
2. Steam distillation of volatile oil-containing drugs.
3. Distillation of crude turpentine, with subsequent rectification of the oil thus secured.
4. Hydrolysis of starch, in the preparation of dextrins and glucose.
5. Hydrolysis of amygdalin-containing drugs, with subsequent testing for glucose, hydrocyanic acid and benzaldehyde.
6. Solubility tests on resins, gums, balsams, gum resins, etc.
7. Preparation of pharmaceutical resins.
8. Preparation of pharmaceutical oleo-resins.

As stated before the students conduct their own demonstrations and explain the nature and purpose of their investigations to their fellow classmates, their classmates in turn, are privileged to ask questions relative to this or similar problems. One might think for a moment that the work on the part of the instructor is greatly facilitated by having the students conduct their own tests, and demonstrations, but experience has shown that the instructor has to devote considerably more time in this connection.

The question of general action and therapeutics has been introduced into the course in Pharmacognosy, because, prior to the time that same was given, almost without an exception, some student or other would ask what the drug in question was used for. No attempt is made whatever to encroach upon the work in *Materia Med-*

ica in relation to action and therapeutics, which course is offered during the Junior year, and which extends over the entire year.

Under the heading of Miscellaneous, might be mentioned notes from collateral readings, some new and interesting discovery, work of drug plant explorers as Drs. Rusby and Rock, the latter in relation to the Chaulmoogra problem. If the student is capable of reading German with considerable ease, as was the case with several during the past year, they are assigned portions of that monumental work by Professor Tschirch, "Handbuch der Pharmakognosie," for translation.

It has been found by experience that a student can devote at least two hours (regular laboratory period), to no more than the study of one important drug.

Drug Plant Research.

In keeping with the policy of the Division of Pharmacy, drug plant research has received ample support and encouragement by the Dean of the Division, Professor E. R. Serles, as well as by the General Administration of the college as a whole. Several research projects are now in progress, the main one being that of an "Ecological and Chemical Study of the American Wormseed," which is now in its third year of investigation. Approximately one and one-half acres of the herb are now under cultivation, which will be later subjected to steam distillation employing the new 250 gallon, boiler plate steel still. Other investigations are those of a continuation of the work on the chemical constituents of *Nicandra Physalodes*; an "Ecological Study of the Insect Flower," also by the writer and a project dealing with the question of U. S. P. alkaloidal assay methods by Professor F. J. LeBlanc, under the direction of Dean Serles.

A modern pharmaceutical research laboratory is now being installed and for which many valuable pieces of equipment have been secured to date, among which are as follows: triple tube combustion furnace; Kjeldahl digestion and distillation equipment; Spencer rotary microtome, electric paraffin oven, electric embedding table; electric drug drying oven, Freas electric oven, electric high temperature furnace; Duboscq colorimeter with lamp; Spencer Abbe refractometer; Cenco Hyvac pump with MacLeod high vacuum gauge and Bogert receiving bulbs; No. 10 Troemmer balance with set of double checked, gold plated weights, up to 200 gms.; complete set of Bureau of Standard certified burettes, pipettes,

volumetric flasks, etc.; No. 2 International centrifuge with interchangeable heads; polariscope; fairly complete set of aniline dyes, etc.

Part II.

A Modern Pharmacognosy Laboratory.

The thought was expressed throughout Part I, the need for instruction in phyto- and micro-chemistry in pharmacognostical studies. This thought has been embodied into the plans of the pharmacognosy laboratory, and which is rapidly gaining favor as an essential for the study of pharmacognosy.

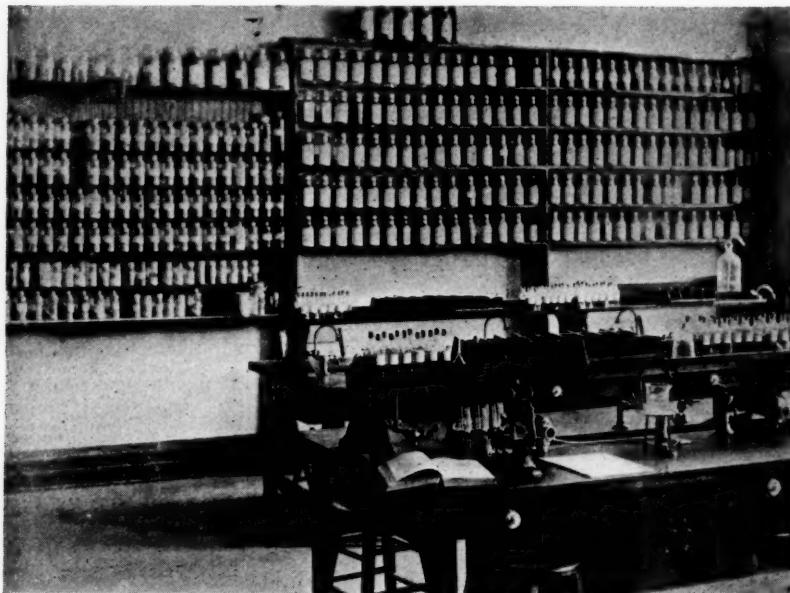
Through the kindness on the part of Dean E. R. Serles, the writer was granted the privilege of developing a laboratory for pharmacognostical studies, according to that which he considered essential, regardless of cost, of course it being understood to be within the available funds of the Division of Pharmacy.

A suite of three rooms was secured, directly opposite the pharmaceutical laboratories, in the north wing, main floor of the new Administration Building for the work in Pharmacognosy and Materia Medica. All three rooms are ideally located, in that they possess a northern exposure, which is of vital importance for laboratory work. One room is devoted to the general pharmacognosy laboratory, the second or central room to a combination of laboratory preparation room and office, and the third for lecture and recitation purposes. The office and preparation room was originally planned as a drug plant research laboratory, but which was changed by the equipping of the main research laboratory.

The equipment for the general pharmacognosy laboratory in main is as follows: four special type pharmacognosy desks; instructor's desk; two crude drug identification cases; collection of preserved and dried drug garden products; wall maps for habitat studies; collection of quaint herbs; B. & L. balopticon; Leitz Edinger photomicrographic, projection and drawing apparatus; twenty-four compound microscopes, two objective type, with 8x and 10x oculars; twenty-four sets of stage and ocular micrometers; twenty-four sets microscopical and micro-chemical accessories; twenty-four special type drug distributing boxes; twenty-four sets pharmacognostical reagents; drug plant herbarium and photographic collection as well as the photomicrographic series.

Special Type Pharmacognosy Desks.

The desks as designed by the writer, are of Kewaunee manufacture of golden oak construction, 2 feet 4 inches in height, 3 feet 8 inches in width and approximately 11 feet in length (inclusive of sink at one end). The table tops are of acid-proof, birch construction, 2 inches in thickness. An acid-proof reagent shelf, 12 inches in height, with central dividing board, straddles a lead-lined trough, the latter running the full length of the desk, and which empties into an alberene stone sink 12 x 12 x 20 inches, inside measurements.



The modern pharmacognosy laboratory showing special type pharmacognosy desks with microscopical and microchemical equipment; N. F. and Nonofficial crude drug identification case (extreme left) and collection of garden products (at right). The U. S. P. set of drugs is to the left of the N. F. and Nonofficial case.

The individual student section is provided with gas, water and electrical facilities, in addition to the special microscopical illuminating feature. Each section is provided with two cabinets and two drawers, which permits of a two-section operation. The water facilities consist of a double control, gooseneck pantry cock, placed beneath the reagent shelf. The electrical outlet was added for purposes of micro-sublimation, ether extraction, etc. In order

to eliminate the dangers involved with alcohol lamps, gas facilities were added. The writer has learned of several serious accidents due to the exploding of alcohol lamps.

The special illuminating feature consists of a 25-watt lamp, inserted in an aluminum coated, half section of an ordinary tin can, cut in such a manner as to allow for two fastener strips. The can is fastened to the under side of the table top, the bulb projecting into a $1\frac{3}{4}$ inch circular opening in the table top, above which is a $\frac{3}{16}$ inch piece of Corning Daylite glass, 2 inches in diameter, flush with the table top. Each lamp is individually controlled by a porcelain snap switch fastened to the apron board.

This device, which has proven very satisfactory during the past two years, and which possesses many advantages over the other systems of microscopical illumination, was added to the desks at the cost of the microscope mirror, the microscopes having been purchased without the mirrors. A 5-watt lamp was first given a trial, but which proved to be insufficient as considerable light is lost by diffusion. As to some of the advantages of this feature, may be mentioned that a uniform light is available at all times. It does away with the handling of the regular type of microscope lamp, is always in place and ready for use, and out of the way. Another advantage is that no matter from which direction the instructor approaches the student, all that is necessary is to revolve the microscope, wherever desired and one is not bothered with the work of adjusting a mirror. A very distinct and unique advantage in connection with projection work, is that the laboratory may be darkened and with the use of the Leitz Edinger projection apparatus, the sections for study can be shown upon the screen, and at the same time the students can avail themselves of the use of the microscopes to study similar sections.

The instructor's desk is equipped in a similar manner with gas, water and electrical facilities as well as the special illuminating device. The latter in connection with this desk is of service for black board demonstration work, whereby the instructor has the section close at hand for observation.

Crude Drug Identification Cases.

In order that the student may have access at all times to the crude drugs for identification purposes, two wall cabinets have been added to the list of equipment, one case being devoted to a

complete collection of U. S. P. IX crude drugs, the other one being devoted to the important N. F. IV and non-official crude drugs. These cases have been found to be in constant use, this or that five or ten minutes before or after a class, vacant periods and even for evening study. One notes a student pick out a certain jar, hand it to his fellow classmate and ask such questions as follows: state the Latin title; state its method of collection and preparation; what are the general uses of same, etc., so it serves many other purposes than that of identification alone.

Garden Collection.

A set of some 200 or more jars of garden products, which is being increased from year to year, consisting of dried, preserved and powdered drug materials is an invaluable collection for laboratory use, as a collection of this kind cannot be purchased. For instance, there is the elecampane root in alcohol for inulin deposition studies; many types of drug plant flowers for morphological studies; fresh belladonna roots and leaves as well as many other drugs for crystal study; American wormseed and Apple of Peru stems for collenchyma studies and so on throughout the entire collection.

Drug Plant Herbarium, Photographic and Photomicrographic Collection.

In keeping with the scientific aspect of the Medicinal and Poisonous Plant Investigations Gardens as well as for instructional purposes, a drug plant herbarium is now in course of preparation, to include those plants placed under cultivation in the gardens and those native to the State of South Dakota. There are many drug plants native to the Black Hills of South Dakota, upon which problem the writer hopes to engage at some later date.

The specimens are mounted on regulation size herbarium paper. Another collection is also being prepared for students' use, on paper one-half the regulation size. This collection will consist of a series of pressed leaves of various types for leaf study in addition to drug plant specimens.

Two things must be borne in mind in the preparation of a drug plant herbarium, one being the questionable authenticity of seed materials and the second the lack of a systematic key for the identification of the specimens.

A collection is also being prepared of drug plant photographs to supplement the illustrations in the various textbooks used in connection with the preparation of the drug monographs in the regular course in Pharmacognosy, in order to acquaint the student with some of the general characteristics of the drug plant from which the drug has been derived. These are used in connection with the collection of quaint herbs, gathered from year to year. The collection of drug plant photographs as well as the herbarium and photomicrographic collection are invaluable also for research purposes.

Photomicrographic Series.

This series of photographs, unique in character for laboratory work, is one which requires not only time and patience in the preparation of same, but considerable expense as well. The photographs are mounted in a printed folder of a good grade of mounting paper, of a steel gray texture on the exterior and white on the interior. The folder measures 5½ inches by 8½ inches. The printing arrangement allows for the title of the subject as well as space for the general characteristics to be noted, as per accompanying illustration. The photographs are made employing the Leitz Edinger photomicrographic apparatus, Wratten and Wainwright "M" panchromatic plates for photomicrographic work, Eastman set of color filters and developed either in total darkness or with the use of the Eastman Safelight. The sections to be photographed are first stained with contrasting stains and then the proper color filter selected as the occasion requires. A set of twenty-four prints are being prepared from each negative and which are distributed to the students, but which are returned at the close of the period. The collection to date includes illustrations of the Umbelliferous fruits, various types of fibrovascular bundles, monocotyledonous and dicotyledonous stem structure, transverse sections of various roots and rhizomes, longitudinal and transverse sections of Cucurbita stem for sieve study, etc. The Division of Pharmacy maintains a well-equipped dark room in this connection, which room is equipped with rapid print machines, plate and print washer, rapid driers and various other dark room necessities. In the preparation of the slides for photomicrographic work, a set of 50 to 100 are generally prepared, stained and mounted in balsam and which constitutes the permanent

slide collection. In many cases the sections are not stained or treated in any manner so as to preserve the pharmacognostical characteristics.

Collection of Quaint Herbs and Roots.

In order to bestow upon the laboratory the touch of the Old Herbalist, who is now in the passing, and also to keep in the mind of those who visit the laboratories that interesting phrase by Bastedo, "Medicine . . . it sometimes cures, often relieves and always consoles," a collection of herbs and roots is suspended at convenient points about the laboratory. Man has always been interested in drugs and drug action, and probably will always continue to be interested, if at no other time than in the time of sickness. These materials are also capitalized in connection with the course in Window Display, and suggests a novel idea for window decoration, to bring the drug store back to the people.

Drug Milling Establishment.

It is hoped, that during the course of the next year or two, it will be found possible to secure sufficient funds to install a modern drug milling establishment, embodying the principles as worked out by Professor E. L. Newcomb at the College of Pharmacy, University of Minnesota. A start in this direction has already been made by the construction of a large drug drying oven which has been in considerable use during the past four or five years, in connection with the Medicinal and Poisonous Plant Investigations Gardens.

REPORT OF THE COMMITTEE ON DRUG MARKET.*

Pennsylvania Pharmaceutical Association.

In summarizing the results, sent in by the various members of the committee, it is always a puzzling matter to make an accurate comparison of the quality of material examined during the present year, and the preceding years, as the controlling factors differ from time to time, so that an exact comparison is not possible. However, it is possible to give a good general outline, particularly in those classes of materials that in the past have been

*Presented to the 1924 Convention at Bethlehem, Pennsylvania.

notoriously substandard. In this class are resins and gum-resins, the most notable example of which is asafetida. Formerly this article was subjected to much mishandling, as could be easily seen by even a casual macroscopic examination, and proven by the chemist who in his examination of the alcohol-soluble matter and ash content separated so much earthy and siliceous material that it resembled a gravel pit. This undesirable condition did not exist during the past year, as every one of the samples of asafetida examined was of U. S. P. quality in every respect. Myrrh also showed this improvement, as only one of the thirteen samples examined failed to comply with the U. S. P. requirements.

It seems to require considerable time and effort to educate some gatherers and dealers as to the proper identity of some drugs. Considering the length of time that certain drugs have been mislabelled, it is time that those responsible for the condition should recognize the fact that *acer spicatum* is not cramp bark, that *ruellia* is not *spigelia*, and that *Bermuda grass* is not *triticum*. The continual substitution of an unidentified bark for *cascara amarga* is another illustration of this condition. Some drugs were only partially contaminated as illustrated by *cimicifuga*, which contained a spurious root. In the class of mistakenly marked products were two samples of bitter orange peel, that were found to be sweet orange peel, and a shipment of stramonium, that was found to be alkanet root. This latter incident is of course a clear case of carelessness, as the two products are totally dissimilar.

Each year we find numerous cases of substandard drugs, in which category we place those drugs wherein the inactive part of the plant was received, and those instances in which an excess of earthy material or other foreign matter was found. In the former case we find *lobelia*, in which the stems were substituted for the dried leaves and flowering tops, and *euphorbia*, consisting also of stems instead of that part of the plant described in the N. F., as the "dried herb," "collected while flowering and fruiting." In the latter case we noted black haw and sassafras containing excessive amounts of adhering wood; Culver's root with an excess of earthy material as indicated by an ash yield of 25.66 per cent., and cotton root bark which contained both adhering wood and earthy matter.

A review of the work done on spices, as reported by Mr. Jos. W. E. Harrisson, revealed the fact that condiments such as allspice, anise, cinnamon, coriander, mace, mustard, marjoram and thyme

were without a single rejection, as all samples were of satisfactory quality. Several spices, however, were rejected for various reasons; mainly on account of the presence of earthy, sandy or stony material. In some cases these are macroscopically detected, as in the case of celery seed, two samples of which were rejected on account of the presence of small stones. Generally, however, they are detected in the ash determination, or the subsequent determination of ash insoluble in dilute hydrochloric acid. In this class were found several samples of cardamon, four samples of capsicum, and several samples of both black and white pepper. Rubbed sage of American origin was also an offender in this respect, as several samples were rejected. The white pepper also had clear evidence of the presence of sand. A sample of nutmeg was considered of unsuitable quality because of the presence of an excessive amount of ether-soluble matter.

In the realm of chemical products we find some outstanding examples as outlined in the following observations by Mr. Blumenschein, who stated that: Of 143 separate specimens of chlorinated lime examined none were equal to the U. S. P. requirement, as they ranged from 16 per cent. to 29 per cent. of available chlorine, averaging about 20 per cent. "Many samples of precipitated sulphur of about 50 per cent. strength and containing calcium sulphate were examined as well as U. S. P. zinc ointment containing petrolatum and a trace of lead and a few cases of substandard preparations such as spirit of nitrous ether and tincture of iodine."

A study of the reports of analysis submitted to by the various laboratories leads us to the conclusion arrived at by Mr. Slothower, who states that "the crude drugs are again the chief substandard drugs," and that "the assay drugs during the past year have been of exceptionally good quality."

In presenting our report the committee has endeavored to cover the field, so that it is of interest and benefit to the retail pharmacists, the manufacturer and the wholesaler, as we feel that there is an indivisible community of interest and that the welfare of one group is the welfare of all, and it is our hope that the vigilance of the various laboratories, contributing to our report, shall be of direct benefit to our membership and to pharmacy in general.

The following data covers the period from June 1, 1923, to June 1, 1924, and was compiled from the files of the H. K. Mulford Co., the LaWall and the Smith, Kline and French Co. laboratories:

Acacia—Powdered.—An excess of water-insoluble matter was the cause of the rejection of two samples. Reported by Jos. W. E. HARRISON.

Acetone.—The examination of one lot showed that it was not of U. S. P. quality as it had a specific gravity of .830 at 25 degrees C. and contained empyreumatic substances in excess of the U. S. P. limit. Reported by R. BERESFORD.

Acetylsalicylic Acid.—Seventeen lots were examined and all were practically free from uncombined salicylic acid. Reported by J. J. FARLEY.

Acid Phosphoric—One carboy was unsatisfactory because of the presence of chlorine. Reported by J. G. ROBERTS.

Alcohol.—The presence of a reddish sediment in one lot showed that it had been placed in a dirty drum. One lot was excessively yellow and appeared to be a by-product alcohol. Two other lots were .3 per cent. low in strength and several lots contained slightly excessive amounts of carbonizable, non-volatile impurities. Reported by J. G. ROBERTS.

Alcohol.—Many samples that were otherwise of U. S. P. quality were rejected on account of the presence of an excess of aldehyde. Reported by Jos. W. E. HARRISON.

Asafætida.—The two lots of gum asafætida examined were found to contain 71.4 per cent. and 70.2 per cent. of alcohol-soluble matter. Two samples of the powdered drug assayed 58.77 per cent. and 56.7 per cent. of alcohol-soluble constituents. As the U. S. P. requires not less than 60 per cent. of alcohol-soluble matter for whole asafætida and not less than 50 per cent. for the powdered it is seen that all lots were of U. S. P. quality. Reported by K. SUTO.

Benzyl Alcohol.—The rejection of two samples was necessary because they were not soluble in water to the extent of the N. N. R. standard of 4 per cent. Reported by E. NEWBOLD.

Benzoin.—Thirteen samples of Sumatra Benzoin assayed 78.36 per cent., 80.59 per cent., 69.87 per cent., 76.71 per cent., 75.4 per

cent, 74.3 per cent., 80.2 per cent., 75 per cent., 76.2 per cent., 74 per cent., 69.1 per cent., 67.1 per cent., and 80.58 per cent. alcohol-soluble constituents. Two samples of Siam Benzoin assayed 99.25 per cent. and 98.9 per cent. The U. S. P. permits not less than 75 per cent. of alcohol-soluble constituents for Sumatra Benzoin and not less than 90 per cent. for Siam Benzoin. Reported by K. SUTO.

Black Haw.—Sixteen samples were examined during the past year and six were found to contain foreign matter in excess of the U. S. P. limit of 5 per cent. They contained 11.2 per cent., 25 per cent., 15 per cent., 6 per cent., 16 per cent. and 6 per cent. foreign matter. Reported by F. McNERNEY.

Calcium Glycerophosphate.—Samples were generally not of U. S. P. quality, particularly because of their incomplete solubility in 50 parts of water. Several lots contained excessive amounts of water, ranging from .4 per cent. to 2.6 per cent. Occasional lots had slightly excessive amounts of chloride or sulphate. One shipment was considered very undesirable because it was .8 per cent. low in strength, contained excessive amounts of chloride, phosphate and heavy metals and was unsufficiently soluble in water. Reported by J. G. ROBERTS.

Calcium Oxide.—The presence of a considerable amount of carbonates and an excess of 6.9 per cent. loss on ignition rendered one lot of unsuitable quality for an U. S. P. product. Reported by J. G. ROBERTS.

Caraway.—One lot appeared to consist of immature fruit. The seeds were very light in color and deficient in flavor, but had not been exhausted as the weight of the unit volume of this sample was 58.6. The unit volume of 100 cc. of Caraway seeds averages 48 gms. Reported by G. SLOTHOWER.

Carbon Tetrachloride.—Satisfactory lots of this drug meeting the N. N. R. standard of "not more than .1 per cent. carbon disulphide" are now being received. Analytical results of samples assayed during the past year showed the presence of .014 per cent., .024 per cent., .024 per cent., .042 per cent., .02 per cent. and .019 per cent. of carbon disulphide. Reported by R. BERESFORD.

Cascara Amarga.—A spurious drug is continually being offered for the genuine drug. The bark is abnormally thin and responds to no alkaloidal reactions. It differs from an authentic sample also in its tannin reaction. Reported by G. SLOTHOWER.

Cimicifuga.—The examination of one sample showed that it contained a spurious root. It appears to be a species of *Actaea*, most likely *Actaea rubra*. Microscopically it showed numerous rosette crystals of calcium oxalate and gave a tannin reaction different from that obtained with the genuine drug. Reported by G. SLOTHOWER.

Cotton Root Bark.—One lot was excessively dirty and contained 14.4 per cent. adhering wood. The N. F. permits the presence of not more than 5 per cent. wood or foreign matter. Reported by F. MCNERNEY.

Cramp Bark.—One sample submitted for genuine bark proved on examination to be a species of *Acer* bark. Reported by G. SLOTHOWER.

Culver's Root.—The total ash content of one sample was 25.66 per cent. The N. F. standard for ash is "not more than 12 per cent." Reported by G. SLOTHOWER.

Euphorbia Pilulifera.—One lot consisted entirely of stems, whereas the N. F. standard is "the dried herb collected while flowering and fruiting." Reported by F. MCNERNEY.

Glyccrin.—All shipments were of U. S. P. quality except one, the rejection of which was recommended on account of its decidedly yellow color. Reported by J. G. ROBERTS.

Glycerin.—Several samples contained an excess of fatty acids and esters which were no doubt caused by carelessness in manufacture. Reported by Jos. W. E. HARRISSON.

Guaiac.—The eight lots examined yielded 78.51 per cent., 84.77 per cent., 82.3 per cent., 88.29 per cent., 87.88 per cent., 86.3 per cent., 86.25 per cent. and 90.03 per cent., respectively, of alcohol-soluble matter. The U. S. P. standard is not less than 60 per cent. alcohol-soluble matter. Reported by K. SUTO.

Hellebore.—One sample contained 1.46 per cent. of total alkaloids and yielded the rather high ash content of 18 per cent. Reported by Jos. W. E. HARRISON.

Kino.—The assay of one sample yielded 44.8 per cent. of alcohol-soluble matter, 39 per cent. soluble in boiling water and a total ash of 3.1 per cent. The U. S. P. requires not less than 45 per cent. of alcohol-soluble matter; not less than 40 per cent. of boiling water-soluble matter and not more than 3 per cent. ash. Reported by F. McNERNEY.

Lanoline.—The rejection of one sample was necessary because of the presence of free fatty acids in excess of the U. S. P. limit. Two other samples contained considerable chlorides but were practically anhydrous as they contained only .04 and .02 per cent. water. Reported by R. BERESFORD.

Liquor Formaldehyde.—All shipments were of U. S. P. quality except that three lots were respectively .2 per cent., .4 per cent. and 1.1 per cent. low in strength. Reported by J. G. ROBERTS.

Lobelia.—One lot consisted entirely of stems, whereas the U. S. P. permits only the dried leaves and flowering tops with a 10 per cent. limit for stems. Reported by F. McNERNEY.

Magnesium Oxide—Light Calcined.—A broker's sample was not of U. S. P. quality because it contained 4 per cent. excess of water and was 2.5 per cent. low in strength according to the U. S. P. method. Reported by J. G. ROBERTS.

Menyanthes.—An unidentified drug was substituted for menyanthes. It differed mainly in the fact that the leaves were attached to the stem in groups of six and seven instead of three. The leaves were only about half the natural size, had only a slight instead of a decidedly bitter taste and did not have crenate edges. Reported by J. G. ROBERTS.

Myrrh.—The following amounts of alcohol-soluble constituents were found in the 13 samples examined: 49.11 per cent., 42.8 per cent., 40.6 per cent., 36.76 per cent., 39.23 per cent., 43.01 per cent., 41.68 per cent., 38.18 per cent., 36.91 per cent., 35.97 per cent., 33.02 per cent., 41.2 per cent. and 42 per cent. The U. S. P. standard is

not less than 35 per cent. alcohol-soluble constituents. Reported by F. McNERNEY.

Oil Birch Tar Rectified.—An abnormal odor was noted in one sample which had a specific gravity of only .8634 at 25 degrees C. Reported by J. J. FARLEY.

Oil of Sassafras—Artificial.—The following results were obtained with this product: Specific gravity at 25 degrees C., 1.064, optical rotation at 25 degrees C., +1.8 degrees; solubility in 90 per cent. alcohol, 1 part in .44 part.

In comparing these results with those given in the U. S. P. for the natural oil we find that they agree with those requirements except that the optical rotation is decidedly lower than the U. S. P. minimum standard of +3 degrees. Reported by J. G. ROBERTS

Orange Peel Bitter.—Although labelled Bitter Orange Peel, two samples were found to be Sweet Orange Peel. Reported by G. SLOTHOWER.

Pepsin.—The rejection of one shipment was recommended on account of its putrefactive odor. Reported by J. G. ROBERTS.

Petrolatum—Liquid.—Practically all shipments were of excellent quality, being of a water-white appearance, free from odor and taste and having a viscosity above 5, according to the U. S. P. method. The viscosity of some shipments could not be determined by this method, as the more viscid samples gave erroneous results on account of the fact that they would not run out of the pipette smoothly. The only objectionable feature in any shipment was in one which had a slight foreign taste. Reported by J. G. ROBERTS.

Podophyllin.—Two samples were soluble to the following extent:

	<i>Choroform</i>	<i>Ether</i>
Sample #1	80.26%	75.1%
Sample #2	74.63%	85.59%
U. S. P. Standard	65%	75%

Reported by F. GLOOR.

Rue.—Another instance of careless gathering is shown in one sample of Rue which consisted almost entirely of stems, whereas the leaves and flowering tops are desired. Reported by F. McNERNEY.

Sassafras Bark.—The presence of 6.6 per cent. adhering wood in one sample showed that it was not within the U. S. P. standard, which permits not more than 2 per cent. Reported by F. McNERNEY.

Senna.—All samples were satisfactory except one, which was considered unsatisfactory on account of its high ash content. Reported by Jos. W. E. HARRISSON.

Spigelia.—The botanical examination of one sample of this drug proved that the lot contained Ruellia Root. Reported by F. McNERNEY.

Styrax.—The two lots examined yielded the following results:

Sample	Alcohol Insol.	Alcohol Sol.	Acid Value	Odor
#1	5.1 %	73.7%	58.7	Good
#2	5.08%	71.3%	57.7	Good
U.S.P. Standard	2.5 %	60.0%	56-85	

Reported by K. SUTO.

Stramonium.—Although labelled as Stramonium the sample was proven to be alkanet Root. Reported by G. SLOTHOWER.

Triticum.—Bermuda Grass is still being offered for the official *Agropyron repens*. Reported by G. SLOTHOWER.

The following table shows the third report on the weight of unit volume of crude drugs made in the Analytical Department of the H. K. Mulford Company during the year June 1, 1923, to June 1, 1924:

Drug	Volume	Weight Gm.	1923-24 Gm.	Average 1921-22 Gm.	Weight 1922-23 Gm.	Remarks
Angelica Seed	100 cc.	14.8				
	"	19.2	—	—	—	Excessively dirty
Caraway	"	46.4				
	"	50.6				
	"	51.3				
	"	58.6	49.4	48.4	49.0	Immature fruit
Cardamon	200 cc.	137.7				
	100 cc.	68.4				
	"	66.2				
	"	65.3				
	"	66.9	66.7	67.37	69.2	
Colchicum Seed	100 cc.	77.				
	"	74.3				
	"	73.9	75.0	70.9	75.9	Assayed .566% Colchicine
Cubeb Berries	200 cc.	64.1				
	100 cc.	31.1				
	"	31.7				
	"	32.0				
	"	29.0				
	"	28.7				
	"	29.9				
	"	30.4	30.4	31.1	30.5	
Ergot	200 cc.	82.5				
	"	95.2				
	"	89.1				
	"	90.7	89.3	95.1	97.9	
Juniper Berries	200 cc.	70.5				
	"	69.5				
	"	68.3				
	"	68.1	69.1		72.9	
Larkspur Seeds	100 cc.	44.8				
	"	45.2				
	"	45.6				
	"	45.				
	"	45.1	45.1	44.7	45.9	
Rhamnus Cathartica	100 cc.	44.3				
	"	46.2	45.2	43.2	43.4	
Xanthoxylum Berries	"	37.8				
	"	36.				
	"	38.1	37.2		29.8	

Reported by G. SLOTHOWER.

The following table shows the results of chemical assays of 99 crude drugs made in the Analytical Department of the H. K. Mulford Co. during the year June 1, 1923, to June 1, 1924:

Drug	# Sample	Assay			Stand.	# Above	# Below
		Lowest	Highest	Average			
Belladonna Lvs.	12	.397%	.625%	.507%	.3	% Alks.	12 0
Belladonna Rt.	5	.356 "	.698 "	.489 "	.45 "	"	3 2
Capsicum	2	17.44 "	23.35 "	20.39 "	15.	" N-V.E. Ext.	2 0
Cinchona Yellow	1	5.91 "	5.91 "	5.91 "	5.	" Alk.	1 0
Colchicum Corm	11	.25 "	.506 "	.345 "	.35 "	Colchicine	7 4
Colchicum Semen	2	.406 "	.566 "	.486 "	.45 "	"	1 1
Guarana	4	4.29 "	4.44 "	4.55 "	4.	Caffeine	4 0
Hydrastis	10	2.97 "	4.19 "	3.49 "	2.5	" Alkaloids	10 0
Hyoscyamus	5	.067 "	.196 "	.151 "	.065 "	"	5 0
Ipecac	5	1.81 "	2.28 "	2.15 "	1.75 "	"	5 0
Jalap	3	7.1 "	11.99 "	9.29 "	7.	" Resin	3 0
Kola Dried	8	1.6 "	2.37 "	1.9 "	1.5	" Caffeine	8 0
Nux Vomica	12	2.2 "	3.2 "	2.8 "	2.5	" Alkaloids	11 1
Opium Gum	2	12.25 "	13.69 "	12.97 "	9.5	" Morphine	2 0
Opium Powder	4	10.69 "	11.54 "	10.92 "	10.0	"	4 0
Physostigma	1	.154 "	.154 "	.154 "	.15	" Alks.	1 0
Pilocarpus	4	.855 "	1.09 "	.995 "	.6	"	4 0
Stramonium Lvs.	1	.445 "	.445 "	.445 "	.25	"	1 0
Sanguinaria	7	2.6 "	6.2 "	4.01 "	2.5	"	7 0
Total	99						91 8

COMPARISON WITH REPORTS PREVIOUSLY SUBMITTED.

Year	Total	Above	Below	Per Cent. Above
1915 Report	133	98	35	73.6
1916 "	215	156	58	72.9
1917 "	172	147	25	85.3
1918 "	131	113	18	86.8
1919 "	206	173	33	83.9
1920 "	211	173	38	81.9
1921 "	217	179	38	82.4
1922 "	96	76	20	79.1
1923 "	144	114	30	79.1
1924 "	99	91	8	91.9

Last year Aconite Root, Opium Powder, Aspidosperma, and Conium leaves were the drugs one-half or more of which ran below

standard. This year Belladonna Root and Colchicum Corm are the only offenders in this respect. The per cent. drugs assaying above standard is the maximum we have ever reported. Reported by G. SLOTHOWER.

The following table shows the results of physiologic assay of 18 crude drugs made in the Physiologic Testing Department of the H. K. Mulford Co. during the year June 1, 1923, to June 1, 1924:

Drug	# Samples	Lowest Assay	Highest Assay	Average	# Above	# Below
Digitalis	14	85%	250%	125%	10	4
Ergot	4	133 "	280 "	140 "	4	—
Total	18				14	4

Therefore 77.7 per cent. of the crude drugs were above standard. Reported by PAUL S. PITTINGER.

Respectfully submitted,

GEO. A. SLOTHOWER,
WALTER V. SMITH,
JOS. W. E. HARRISON,
F. J. BLUMENSHEIN,
J. G. ROBERTS,

Chairman.

ABSTRACTED AND REPRINTED ARTICLES

FIREPROOFING AND FIRE-EXTINGUISHING AGENTS.*

A Summary of Modern Developments.

The principles underlying the protective action of fireproofing agents or "antipyrenes"—first recognised by Gay Lussac—are, firstly, the dilution of the combustible vapours, so as to render them practically non-inflammable; and, secondly, the formation of an indestructible surface-coating. Little difficulty is experienced in effectively fireproofing such materials as unexposed timber, but the case

*Reprinted from the *Pharmaceutical Journal*. (Original source: *The Chemical Trade Journal*, London, England.)

is very different with fabrics which have to withstand laundering. A case in point, which has been the subject of close study, is the proofing of flannelette. Here the protection afforded must not only withstand the rigours of the washboard, but the proofed fabric must not be tendered nor exercise any injurious action on the skin.

As was stated at the recent Aeronautical Congress, a pressing problem, and one beset with many difficulties, which is now receiving attention, is the fireproofing of the doped fabric structures composing the wings of aeroplanes. For a successful solution, the proofing would require to be not only highly efficacious and able to withstand weathering without deterioration, but it must also not tender unduly the linen fabric nor "weight" it appreciably.

In the field of fire-extinction much attention is being paid to the use of foam-producing compositions, particularly in the case of oil-fires. Oil refineries are now equipped with large installations based on this principle, an equipment, the need for which will be realised, when it is stated that, during the decade 1908-1918 nearly 13 million barrels of oil were destroyed by oil-fires in the United States alone. Out of a total of 500 of these conflagrations more than 300 were caused by lightning. Carbon tetrachloride is now extensively used for extinguishing oil and electrical fires, but, according to a recent American Governmental report, its haphazard use, particularly in confined spaces, is attended with some danger owing to the toxic nature of its decomposition products.

The Use of Ammonium Compounds.

Ammonium phosphate ($\text{NH}_4\text{)}_2\text{HPO}_4$), is endowed with both the desiderata of an efficient fireproofing agent, it readily liberates ammonia, a gas of low inflammability, and leaves a fusible residue of metaphosphoric acid. Its high solubility, however, precludes its successful use in materials which have to withstand laundering and weathering. Combustible materials coated with the phosphate char in contact with a flame and glow only with great difficulty. For this reason matches are impregnated with it to produce non-glowing match-ends. In order to proof wood, ammonium phosphate may be used in conjunction with boric acid, a solution, suitable for treating wood by immersion, containing 100 Gms. of the former and 10 Gms. of the latter per litre. It is claimed that wood, so impregnated, can be worked like the untreated material without detriment to the tools, and that it will not injure paint, varnish, nails, or screws.

In the manufacturing of fire-resisting varnishes, the addition of 5 per cent. of ammonium phosphate is recommended, as this proportion will not render the film opaque. Owing to its solubility, however, higher proportions are readily dissolved out on exposure. For the prevention of smouldering, vegetable fibres, such as kapok, may be impregnated with 2 per cent. solutions of ammonium phosphate or borate, or with a 6 per cent. solution of microcosmic salt (*Brit. Pat.*, 130,662, of 1919). On heating, the latter fuses and evolves ammonia, leaving a coating of fire-resistant sodium metaphosphate.

Ammonium phosphate $(\text{NH}_4)_2\text{HPO}_4$, is endowed with both proofing solutions, but, owing to its property of sublimation from heated materials, fusible non-volatile substances, such as borax and boric acid, are usually added to assist its protective action. For instance, Gleichmar's solution consists of 133 Gms. of ammonium chloride, 33 Gms. of borax, and 17 Gms. of salt per litre. The tendency of this solution to deteriorate fabrics, through its acid properties, cannot easily be countered by the presence of alkaline compounds, owing to the decomposition of the chloride set up by the latter. For proofing fabrics, a mixture of ammonium chloride, ammonium phosphate, and alum, in the proportions of 2: 1: 1, has been suggested, dilute acetic acid being added to avoid attack on the dye (*Brit. Pat.*, 113,162, of 1917). Such a mixture, consisting as it does of three acid substances, would almost certainly tender the fabric. Ammonium bromide is claimed to be a more effective protection from ignition than the chloride (*Ger. Pat.*, 355,107, of 1918).

Ammonium sulphate is seldom used alone, because of its acid reaction. On this account the Hall Lumber Company combines its use with that of an alkaline re-acting salt such as trisodium phosphate (*U. S. Pat.*, 1,080,966, of 1913). Borax may also be used in conjunction with the sulphate.

Compounds of Boric Acid.

Owing to the facility with which metallic borates fuse to form glass-like sealing films, stable under heat, these compounds find extensive use in fireproofing media. A notable example is zinc borate, a substance which has received close attention at the hands of the United States Government research departments. Thus, together with the corresponding lead compound, its use in fire-resistant paints has been covered by patents, which have been dedicated to the public. (*U. S. Pats.*, 1,265,549 of 1918 and 1,216,729 of

1917.) For fireproofing fibrous material with lead borate the material is first saturated with a solution of a borate, dried, and the insoluble lead compound precipitated by treatment with a soluble lead salt. Impregnation with zinc borate by a similar process is recommended by the U. S. Forest Products Laboratory as being particularly suitable for imparting incombustibility to roofing shingles. In this case the shingles are impregnated with borax, dried until the moisture content does not exceed 10 per cent. Then follows the injection of zinc chloride, when the insoluble borate remains in the pores.

Complex borates, which should have the advantage of lower melting-points than the simpler constituent compounds, have also found application. Thus, for fireproofing aircraft linen, the double zinc-sodium borate, prepared by mixing boiling solutions of zinc-ammonium sulphate and borax, has been suggested (*Brit. Pat.*, 120,421 of 1917). The material is applied in a gelatin medium containing borax and ammonium chloride. A similar medium is that of Flatters, who proposes, for this purpose, a complex composition consisting substantially of magnesium and sodium borates suspended in a colloidal mixture of soap, glycerol, glue, and gelatin (*Brit. Pat.*, 120,465 of 1918).

In many fireproofing compositions boric acid is added to the borax both to enhance the fusibility and to neutralise the alkalinity of the borax. A mixture of borax, trisodium phosphate, and potassium carbonate has been suggested for the dual purpose of fireproofing and fire-extinguishing. On account of their solubility, however, the use of the alkali borates is much restricted.

Fireproofing With Water Glass.

On account of its glass-like nature and stability at high temperatures, water glass enters into the composition of many fireproofing media. Wood may be painted with water glass alone, or with a hot mixture of sodium silicate, glue, and Spanish white (chalk). For textiles, silica may be deposited by after-treatment with dilute hydrochloric acid, followed by washing and heating, but this treatment imparts harshness to the fabric. A rubber emulsion, containing water glass, borax, and a metal powder, has been suggested for water-proofing and fireproofing fine fabrics such as lace (*Brit. Pat.* 160,627 of 1920).

The adhesive properties of sodium silicate are turned to advantage both in coating materials with solid fireproofing composi-

tions and in the formation of fireproof masses containing steel wool, silicate cotton (slag wool), or asbestos. Thus a fireproof coating for wood is made by treating solid sodium silicate (350 parts) and asbestos powder (350 parts) with boiling water (1000 parts); or the wood is first treated with a mixture of equal parts of magnesium silicate, sodium phosphate, and borax, and subsequently finished with water glass (*French Pat. 472,172* of 1914).

Resort is frequently had to treatment with calcium compounds in order to impart water-resistance. Thus, a cement, for converting sheets of paper into fireproof pasteboard, consists of potash water glass (5-10 per cent. free alkali) mixed with chalk (*Ger. Pat. 298,129* of 1916). Fireproof masses may be made by moulding a mixture of slag wool, filler and water glass, followed by treatment with a solution of calcium chloride, while the structural material "Uralite" is made by spraying asbestos with a mixture of water glass and sodium bicarbonate.

Magnesium Compounds.

Magnesium ammonium phosphate, which decomposes on heating into magnesium pyrophosphate and ammonia, has been patented by the Du Pont Company of America for reducing the inflammability of cellulose-ester and oil-varnish films. In the latter case the boiled linseed oil is incorporated with about one-third its weight of the phosphate (*U. S. Pat. 1,316,881* of 1919).

For fireproofing and preserving wood, the material may be impregnated with a solution of the double ammonium magnesium sulphate or with cuprammonium sulphate. In order to lower the melting-point of the magnesium sulphate, sodium or potassium sulphates may be added, preferably in quantity to form the eutectic mixture—that is, the mixture with the lowest melting-point (*Ger. Pat. 306,600* of 1914).

Calcium sulphate or barium carbonate may be deposited in the body of the wood, the former by impregnation with ferrous sulphate followed by treatment with calcium chloride, the latter by treatment with a solution of barium sulphide and subsequent injection of gaseous carbon dioxide (*U. S. Pat. 1,346,287* of 1920).

Compounds of Zinc and Aluminium.

In addition to the borate of zinc, described above, the chloride is used to impart fire-resistance as well as immunity from destructive organisms to wood. To counteract acidity, the chloride may be

dissolved in ammonia and the excess neutralised with boric or phosphoric acid. Zincate solutions (2 per cent. zinc), stabilised by the addition of ammonium salts, have also been proposed, while the American Pyrene Company have patented a mixture of zinc phosphate and an ammoniacal solution of zinc chloride (*U. S. Pats.* 1,318,524 of 1919, and 1,261,736 of 1918).

Alum has been used for fireproofing textiles, in combination with lime, or with the sulphates of ammonium, sodium, or potassium. In order to impregnate fabrics with adherent hydrated alumina, they are soaked in a solution of sodium aluminate (sp. gr. 1.13), treated with carbon dioxide at 105° C. under a slight pressure, then washed and dried; or the aluminate may be decomposed by treatment with sodium bicarbonate. Another method is to moisten the alum-impregnated material with bicarbonate and then to treat with steam or with carbon dioxide at 100° C.

To reduce the inflammability of paper, a paste of sodium aluminium carbonate may be incorporated with the pulp (*Brit. Pat.* 23,421 of 1914). With a view to suppressing the tendency of such proofed materials to smoulder at the edges, they may be treated with a colloidal solution of sulphur, prepared from sulphuretted hydrogen and sulphurous acid. Solutions of sulphur in volatile organic solvents are also applicable (*Brit. Pat.* 130,743 of 1918). According to W. H. Perkin, rubberised fabrics, as used for tyres, may be rendered non-inflammable by the addition of hydrated alumina alone or mixed with asbestos (*Brit. Pat.* 125,622 of 1916).

A complex composition consisting of manganous chloride (33), orthophosphoric acid (20), magnesium carbonate (12), boric acid (10), ammonium chloride (25), and water (1000 parts), will fire-proof wood when this is boiled for 8 hours with the medium.

Use of Tin and Antimony Compounds.

The highly combustible nature of certain fabrics like flannelette and muslin led to an exhaustive study of the problem of reducing their inflammability. This work culminated in the process due to W. H. Perkin, patented in 1902, according to which the fabric is impregnated with hydrated stannic oxide. Described briefly, the fabric is soaked in a solution of sodium stannate, $Na_3SnO_3 \cdot 3H_2O$, ("preparing salt"), of specific gravity 1.225 at 15° C., squeezed, and passed over drying drums. A solution of ammonium sulphate (sp. gr. 1.075) is then applied, and the resulting sodium sulphate removed by washing. Material treated in this way has its dyeing

properties unaltered, and is without deleterious action on the skin. With tin at £200 per ton, the cost of fireproofing "Nonflam" flannelette works out at about one penny per yard, according to the inventor's statement (8th Inter. Congr. App. Chem., New York, 1912). In a modification of this process, after impregnation with sodium stannate, the fabric is treated with a titanium-salt solution, followed by fixing with sodium silicate.

A drawback in the use of oxides is their tendency to act as combustion catalysts by surface action, and thus to promote glowing in presence of combustible vapour. Such an effect is especially noticeable where the fabric is painted, varnished, or doped, and may, under favourable circumstances, lead to the ignition of any gaseous decomposition products.

Within the last few years numerous patents have been granted to Arent to cover the use of antimony and bismuth trichlorides for fireproofing. These chlorides will dissolve in many organic solvents, such as carbon tetrachloride, carbon bisulphide, amyl acetate, or benzol, and are hydrolysed by water to form insoluble basic compounds. They can also be incorporated with organic wood-preserving and waterproofing materials.

A suitable medium for both reducing the inflammability of and creosoting timber consists of a solution of antimony trichloride dissolved in creosote (2 lb. $SbCl_3$ per gallon). Tar and asphalts may be incorporated with about one-fifth their weight of the chloride (Brit. Pat. 146,099 of 1920). A fire-resisting varnish is composed of a drying oil and a solution of antimony chloride in one of the volatile solvents already mentioned. To fireproof fabrics, they are treated with a solution of the trichloride in carbon bisulphide or carbon tetrachloride, the solvent evaporated, and the chloride hydrolysed by exposure to steam or water. Waterproofing agents, such as rubber, may also be added to the antimony solution (Brit. Pat. 132,813 of 1919). In the preparation of non-flaming plastic masses from cellulose derivatives, such as the nitrate, the material may be dissolved in amyl acetate containing antimony chloride (Brit. Pat. 138,641 of 1920).

Compounds of Tungsten and Zirconium.

Sodium tungstate is much used both by itself and in conjunction with other fire-retarding compounds. In some experiments on its protective action recorded by Sibley (*J. Ind. Eng. Chem.*, No. 8, 1921), impregnation of cotton fabrics with a 3 per cent. solution

was found to be equally as efficacious as treatment with a more concentrated solution. For the protection of tulle, muslin, and other delicate fabrics impregnation with a solution containing 10 Gms. tungstate, 125 Gms. ammonium phosphate, and 7 Gms. boric acid per litre has been proposed. This solution is added to the finishing medium (gum, starch, or dextrin) in the proportion 1:4. Ammonium chloride, ammonium sulphate, and aluminium acetate may also be combined with sodium tungstate. A medium particularly recommended for artificial silk can be prepared by diluting a mixture of the following solutions: 100 parts aluminium acetate (sp. gr. 1.13), 10 parts acetic acid (sp. gr. 1.06), and 200 parts sodium tungstate (sp. gr. 1.40). Water-resistance can be imparted by using an excess of the acetate (*Brit. Pat.* 175,746 of 1920).

According to Mond (*Brit. Pat.* 4457 of 1915), zirconium hydroxide may be applied to fabrics as a hydrogel, prepared by steeping in a solution of the aceto-nitrate containing magnesium sulphate, draining, heating to 65° C., and finally washing. One litre of the steeping medium should contain 200 Gms. magnesium sulphate and 20 Gms. of the aceto-nitrate, prepared by evaporating zirconium nitrate with acetic acid. To enhance the fire-retarding effect, the treated fabric may be allowed to absorb phosphoric acid. Another method is to impregnate the material with a solution of precipitated zirconium phosphate in concentrated oxalic acid.

Organic Fireproofing Agents.

As is to be expected, the principal members in this group are highly chlorinated or brominated substances, depending for their effect on the evolution of non-inflammable vapours. One such composition consists of brominated coal-tar dissolved in pitch. Bromination is effected by treating the tar with half its weight of bromine, after which the product is dissolved in 20 parts of pitch and the mixture applied to the wood in the molten condition (*U. S. Pat.* 1,194-558 of 1916). The chloro-naphthalenes have also been applied in reducing the inflammability of asphalt. According to another specification, fibrous material is impregnated with the sodium salt of a polychlorophenol or chloro-acid and the free phenol or acid then precipitated. These compounds decompose below 400° C., and may be used in conjunction with an inorganic fireproofing agent. Solutions of the sodium salts may also be utilised for putting out fires (*U. S. Pats.* 1,085,783-4 of 1914).

Solutions of algin, or alginic acid, have been suggested for fireproofing inflammable aircraft materials. This is a nitrogenous product obtained from certain species of seaweed by extraction with sodium carbonate, precipitation with acid, and final purification by dialysis (*U. S. Pat. 1,321,708* of 1919).

Methods of Application and Testing.

In the fireproofing of wood the methods of impregnation are closely similar to those used in applying wood preservatives.† The pressures applied will depend on the structure of the wood, as an excessive pressure will tend to crush the cells. Too high a temperature during drying may lead to brittleness. In order to assist penetration, an initial vacuum may be applied, followed by injection under about 170 lb. pressure. In the application of water glass and its subsequent precipitation with hydrochloric acid, salt is left in the wood. To obviate this, it has been proposed to utilise pure silicic acid, prepared and impregnated by electro-osmotic methods (*Brit. Pat. 101,205* of 1917).

Many fibres, such as kapok, have cuticles which are penetrated with difficulty by soluble salts. To facilitate penetration in such cases the material may be treated with alcohol or other volatile solvent or with a dilute solution of hydro-fluoric acid (2 parts of the commercial acid in 100 parts of water). Coating with metal by electro-deposition is suggested as a method of fireproofing aircraft linen without loss of tensile strength (*Brit. Pat. 149,745* of 1919).

For most practical purposes, the direct method of testing the efficacy of a fireproofing treatment—that is, by applying a flame—should be sufficient. In certain cases, notably for aircraft fireproofing, some method of testing the comparative protective action is necessary. Very little information is available, however, with regard to the inflammability of fireproofed fabrics, although some results of comparative tests with unproofed materials have been made public (Aeronautical Advisory Committee Report, No. 573, of 1918). The three methods used for determining the ease of ignition of doped fabrics were as follow: An approximate ignition temperature determination by heating in a metal tube; determination of the size of celluloid cube necessary to cause ignition together with the rate of burning of the fabric; and determination of the proportion of

†See *Chemical Trade Journal and Chemical Engineer*, October 5, 1923, page 391.

alcohol in a carbon-tetrachloride-alcohol mixture, burning on a cylinder of plaster of Paris, necessary to ignite the fabric.

The Tendering Action of Fireproofing Agents.

Although fireproofing generally tends to weaken the fabric, the published quantitative information is very meagre. Sibley has determined the tensile strength of tyre duck fabrics after treatment, on a small scale, with seven different fireproofing media (*J. Ind. Eng. Chem.*, No. 8, 1921). Pieces of the fabric (1 in. by 6 in.) were boiled for 15 minutes in the solutions, then lightly wrung out, and allowed to dry in the air for three days so that they had the same water-content, all the experiments, as well as the control, being carried out simultaneously. The highest and lowest results (of three tests) for each medium are given below, the figures representing the breaking strength in pounds per inch.

Treatment	(36 oz./sq. yd.) Heavy Fabric	(18½ oz./sq. yd.) Light Fabric
Control (boiled 15 minutes in distilled water) ...	302 .. 286	212 .. 180
Boiled with saturated aluminium sulphate,		
$\text{Al}_2(\text{SO}_4)_3 \cdot 13\text{H}_2\text{O}$, dried at 80° C., then treated with saturated sodium carbonate	—	—
Ammonium chloride 40, borax 10, salt 5, and water 300 parts	200 .. 184	185 .. 170
Borax 35, glucose 18, water 300 parts	104 .. 150	154 .. 144
Sodium-tungstate solution, 3½ per cent. $\text{Na}_2\text{WO}_4 \cdot 2\text{H}_2\text{O}$	264 .. 222	210 .. 188
Borax 45, $\text{MgSO}_4 \cdot 22\frac{1}{2}$, water 300 parts	200 .. 200	178 .. 155
Control	333 .. 304	229 .. 212
NH_4Cl 15, $\text{Na}_2\text{B}_4\text{O}_7$ 3, H_3BO_3 6, water 300 parts, Sodium-tungstate solution, 15 per cent. $\text{Na}_2\text{WO}_4 \cdot 2\text{H}_2\text{O}$	209 .. 200	215 .. 184
	292 .. 238	230 .. 200

The sodium-tungstate solutions had the least weakening effect, while tests were impossible with the fabrics treated with aluminium sulphate followed by sodium carbonate, owing to their extremely deteriorated condition.

Tenacious Foam-forming Mixtures.

According to the investigations of the U. S. Bureau of Mines (Bulletin No. 170), the most practicable method of dealing with oil-tank fires is to spread on the surface of the oil a thick, tenacious foam consisting of tough bubbles inflated with carbon dioxide. Such a foam is usually obtained by mixing a sodium-bicarbonate

solution containing a froth-stabiliser with an acid salt. A highly-recommended mixture comprises a pair of liquids of the following composition:

- A. Aluminium sulphate, 10; sulphuric acid (sp. gr. 1.71 at 15°)
- C.) $\frac{1}{2}$; water, 100 parts.
- B. Sodium bicarbonate, $7\frac{1}{2}$; ground glue, $1\frac{1}{4}$; arsenious oxide, $\frac{1}{52}$; water, 100 parts.

The proprietary extinguisher "Foamite" has a closely similar composition. Other stabilisers may replace glue, as, for example, liquorice-root extract, saponins, soap bark, the phlobaphenes, and sodium silicate. The cost of such an installation is estimated to be about 3 cents per barrel-capacity of the tanks protected. To increase the efficiency of the ordinary bicarbonate-acid extincteur, foam-forming compounds may be added to the alkali solution and carbon tetrachloride may be added to sulphuric acid of similar density.

Many carbonate and bicarbonate solutions containing water-soluble organic compounds have been patented. A few such mixtures are sodium bicarbonate with sodium lactate, potassium citrate or a phosphoprotein, potassium carbonate with glycerin or sodium lactate, and ammonium carbonate with glycerin (*U. S. Pats.* 1,278,-714-6 of 1918, 1,375,779 of 1921, and 1,306,707-9 of 1919). A very effective mixture consists of sodium sulphite and ammonium chloride in molecular proportions.

Carbon Tetrachloride as Fire-extinguishing Liquid.

Owing to the formation of a heavy, non-inflammable vapour blanket in contact with a heated surface, carbon tetrachloride is extensively used for putting out small fires. When applied to electric-arc and similar fires, there is no danger of electric shock, but its general use in the absence of efficient ventilation is not without risk. Recent investigations by the American Bureau of Mines (Technical Paper No. 248) have shown that toxic quantities of phosgene (COCl_2), chlorine, and hydrochloric acid gas result from its decomposition in contact with heated iron or with a fire. In some experiments made by passing the tetrachloride mixed with air through a heated quartz tube at $600\text{--}800^\circ\text{ C.}$, one-half was decomposed into toxic products. The addition of turpentine reduced the amount of free chlorine, but was without appreciable effect on the proportion of phosgene.

According to Henning (*J. Soc. Chem. Ind.*, No. 10, 1922), methyl bromide (B. P. 4.5° C.) does not give rise to dangerous decomposition products, and would, moreover, be self-propelling and also very resistant to cold (freezing-point, —84° C.). A host of mixtures of carbon tetrachloride with small quantities of other organic liquids have been recently patented, chiefly in America. In the majority of cases the object of these additions is to lower the freezing-point, and saturated or chlorinated hydrocarbons, aromatic esters, aniline, aceto-phenone, anisol, and propionic acid are some of the compounds recommended for this purpose. Inorganic fire-resisting materials have also been incorporated with chlor-hydrocarbons, while a recent specification proposes to combine the use of the latter with materials based on the "Foamite" principle (*Brit. Pat.*, 201,379 of 1922).

MEDICAL AND PHARMACEUTICAL NOTES

ETHYLENE GAS IN FLORICULTURE.—For several years florists have been using anæsthetic gases, such as chloroform vapor, to stimulate the growth of forced plants and flowers. It is highly probable that ethylene, which has received much attention lately as a rival of laughing gas as an anæsthetic, will replace the more expensive and less satisfactory gases in greenhouse culture. This gas has a remarkable power in inducing growth in dormant organs or in modifying the nature of growth already occurring. It also has the advantage of low toxicity.

A SUBSTITUTE FOR CAMPHOR.—Dr. Max Hartmann, in the *Schweiz. Ap.-Zeitung* (1924, 62, 355), describes a complex pyridin derivative which is claimed to be a satisfactory substitute for camphor and to have the advantage of being freely soluble in water. Its systematic name is given as pyridin-beta-diethyl-aminocarbonic acid. The trade name is "coramin." It is a clear, viscous slightly odorous and almost tasteless oil, distilling under very low pressure at 150 degrees C. It is freely soluble in water and common organic solvents. Therapeutic experiments seem to show that it is capable of being substituted for camphor and having the great advantage of free solubility can be administered by the mouth, and prompt effect obtained.

H. L.

STAINLESS IODINE OINTMENT.—

A.	B.
Iodine	Iodine
Ol. Lini	Ol. Arachis
Paraff. Moll.ad 100	Paraff. Moll.ad 100

Method.—Rub the iodine with the oil in a warm mortar until solution is effected. Add the melted soft paraffin, mix thoroughly, transfer to an evaporating basin and heat gently on a water-bath until combination is complete, as indicated by the development of a greenish colour.

Prepared from formula A, the loss of iodine is too slight to be detected. Formula B—a minute loss seems unavoidable, but it is small enough to be negligible.—(*Pharm. Journ.*)

EGGS—FRESH AND OTHERWISE.—

CHARACTERISTICS OF A FRESH EGG.

Before the candle.

Air space: Not enlarged; less than three-fourths inch in diameter.

White: Firm and clear.

Yolk: Dimly seen through the white as a shadowy object indistinct in outline. The chick spot is not visible.

Distinguishing characteristics:
No shrinkage and general firm conditions of white and yolk.
Edible.

Out of shell.

White: Firm and thick; opalescent; reflects the light.

Yolk: Spherical and firm; chick spot small with no sign of hatching. Color is uniform for the entire yolk, but varies in color from light yellow to deep orange, and is occasionally olive green.

Distinguishing characteristics:
General firm condition of white and yolk. White, opalescent.

CHARACTERISTICS OF AN EGG WHICH IS NOT FRESH.

Before the candle.

Air space: Enlarged; the lower wall may be movable in outline.

White: Thin and clear.

Yolk: Definite in outline; sometimes weak, and may occasionally have dark mottled areas.

Out of shell.

White: Thin, no opalescence, does not reflect the light as much as does a fresh egg.

Yolk: Flattened, and occasionally may have light, mottled areas.

Before the candle.

Out of shell.

Distinguishing characteristics: *Distinguishing characteristics:*Enlarged air cell and increased
contrast between white and
yolk as compared with a fresh
egg. Edible.

Thin white and flattened yolk.

ASSAY OF CALOMEL OINTMENT.—For this ointment the method given by Evers and Elsdon (*Analyst*, 1922), based on the U. S. P. method for the assay of calomel, was used. Three difficulties were encountered in the process: (a) The solution of calomel in the iodine solution was slow. (b) The ether solution of fat, if concentrated, carried particles of calomel through the filter, as has previously been observed with yellow mercuric oxide. (c) It was difficult to transfer the whole of the heavy calomel on to the filter. The method was therefore modified as follows:

About 1 Gm. ointment was weighted on to a piece of parchment paper, which was then placed in a stoppered bottle and the fat extracted with three washings of the petroleum spirit (30 cc., 10 cc. and 10 cc.), allowing to settle and decanting through a filter each time. The filter was well washed with more petroleum spirit until quite free from fat, dried, and then added to the dried residue in the bottle: 2 Gms. KI and 25 cc. N/10 I were then added, and the whole left for twenty-four hours, with frequent shaking, or until the calomel was completely dissolved.

The excess I was then titrated with N/10 $\text{Na}_2\text{S}_2\text{O}_3$.

Ointment No. 1.

19.92 per cent. HgCl.
20.00 per cent. HgCl.
20.11 per cent. HgCl.

Ointment No. 2.

20.53 per cent. HgCl.
20.35 per cent. HgCl.
20.58 per cent. HgCl.
20.62 per cent. HgCl.

—(I. R. in *Pharm. Journ.*)

JAPAN ADOPTS METRIC SYSTEM.—The metric system of measurement became official in Japan on July 1, of this year, according to a recent imperial ordinance, says advices to the Department of Commerce from Tokyo. An ordinance puts into effect a law passed in 1921, providing for the use of the metric system, with a view of gradually displacing the complicated Japanese weights and measures. The Government for some time has been conducting an edu-

gational campaign, in order to popularize the system, and has staged demonstrations in various cities.

This law does not contemplate the immediate universal use of metric units, since it is realized that it will require considerable time to overcome the numerous difficulties. The great majority of the Japanese people understand only the native units and are very conservative and prone to stick to old customs and habits. Furthermore, there are very formidable physical and financial difficulties to overcome. The replacement of the present scales used by the Imperial Government Railways, for example, will mean the purchase of several thousand new scales at an expenditure of possibly 1,000,000 yen.

BOOK REVIEWS

THE VERLAG VON CURT KABITZSCH, LEIPZIG, sent the following three books for review:

NEBENWIRKUNGEN DER MODEREN ARZNEIMITTEL. Von Prof. Dr. Otto Seifert in Würzburg. 2 Auflage. Lex. 427 pp.

In this excellent work the newer remedies are arranged in alphabetical order, according to their common or trade-marked name. This is followed by the chemical name, physical and chemical properties, therapeutic action, uses and dosage. Much valuable information is given as, for instance, on page 27, that the dose of Antipyrine is the same number of decigrammes as the number of years the child is old, or the same number of centigrammes as the number of months the child is old. On page 347 the caution is added that medicines should be avoided which render the urine alkaline when Urotropin or Hexamethylenamine is administered, as the latter will not decompose and therefore will be inactive.

The untoward effects of each remedy are systematically grouped and arranged. The literature of all countries—not forgetting the United States—has been thoroughly searched and the names of authors and journals are cited. How thorough this is done can be seen from the following few examples:

Antifebrin, two pages and fifty-three references.

Urotropin, two pages and sixty references.

Scopolamine, four pages and ninety-two references.

Stovaine, four pages and 122 references.

Veronal, six pages and 164 references.

Antipyrine, eight pages and 220 references.

Atoxyl, seven pages and 238 references.

Surely a proof of that proverbial German diligence and thoroughness! The book is equally important and useful for physician, chemist and pharmacist.

DORNBLEUTH'S ARZNEIMEITTEL DER HEUNТИGEN MEDIZIN. Bearbeitet von Prof. Dr. med. C. Bachem in Boston. 14 Auflage. 12 mo. 523 pp.

The first edition having been published in 1872 and the fourteenth in 1923 proves, without doubt, the usefulness of this book. The chief part, pages 28 to 282, is devoted to the remedies of today's medicine—not only the new remedies. Besides the description, action, use and dosage many tried and proven prescriptions are added. Under the proper heading all the acids, salts and preparations are given, for instance, under Acetum there is included Acetum Aromaticum, Acidum Aceticum, Acidum Trichlor-aceticum, Kalium Aceticum, Liquor Kali, Acetici, Natrium Aceticum, Acetum pyrolignosum crudum and rectificatum and Irrigal Tabletten, a specialty, under the heading "Hypnotica," all the hypnotics are enumerated and described.

Under Apocynum, page 44, the statement is made *without* accumulative action. To this the referee cannot subscribe—see N. F. IV, page 269.

The book also contains chapters on: Practical Hints, Maximum Doses, Children's Doses, Inhalations and Therapeutic Notes divided into twelve parts, including also Antidotes. Besides all this there is a very complete Therapeutic Index and a Subject Index. Let us hope that "Dornblüth" will continue to live for many years to come and will remain a practical book for physician and pharmacist the world over.

BAKTERIOLOGISCH—CHEMISCHES PRAKTIKUM. Für Apotheker, Nahrungsmittel Chemiker und Aerzte. Von Dr. Johannes Prescher und Victor Rabs. 4 Auflage von Dr. J. Prescher, 387 pp. mit 70 Abbildungen und 3 Tafeln.

The division of the book is the following:

A. Bacteriological and Biological Methods, including Water and Blood Analysis.

- B. Food Analysis: Milk, Butter, Lard, Oleomargarine, Cacao, etc.
- C. Clinical Analysis: Urine, Exudates and Transudates, Sputum, Blood, etc.
- D. Appendix: Notes and Tables on the Refractometer.

The book is nicely illustrated and the three plates in colors are work of art. We can highly recommend this text to all interested and especially to professional pharmacists who do this work or want to become acquainted with it.

OTTO RAUBENHEIMER, Ph. M.

Verlagsbuchhandlung von Franz Deuticke in Wien und Leipzig, well-known publishers of pharmaceutical, medical, chemical and other scientific works, submitted the following books for review:

VORLESUNGEN UBER DIE PHYSIKALISCHEN GRUNDLAGEN DER NATURWISSENSCHAFTEN. Von Prof. Franz Exner, Universität Wien. 2 Auflage mit 97 Abbildungen. Lex. 734 pp.

This deep but highly instructive volume treats the physical foundation of the natural sciences. The Vienna professor in an interesting manner divides this subject into ninety-five lectures. Numbers 1 to 36 are devoted to Space, Time and Mass; numbers 37 to 62 to Matter and its Constitution; numbers 63 to 85 to Ether, and numbers 86 to 94 to Nature's Laws. Lecture number 95 contains a Résumé and Conclusions. An eight-page double-column index makes the book still more valuable. The ninety-seven illustrations greatly help to elucidate the text. The author treats the subject from a practical standpoint and for that reason we can highly recommend the book.

SELBSTBEREITUNG PHARMAZEUTISCHER SPEZIALITATEN. Von. J. Mindes, Mag. Pharm. 4 Auflage. 12 mo. 157 pp.

The author, a well-known Austrian retail pharmacist, has written a number of books and the one before us is an important one in its fourth edition. A large variety of formulae are given, a variety which can be seen from the following few examples: Acetum Odorificatum, Brilliantine, Depilatoriam, Elix. Colchici Co. (loco Elixir Laville), Lac Cucumeris, Livola de Composé, Spiritus Pini Comp., Syrupus Pectoralis, Tinctura Matricaria, Unguenta Stearin, Vinum Myrtilli, Vinum Pepsini and Wanzen gift (Bedbug Poison).

Pages 135 to 138 contain the Pfarrer Kneipp Remedies, and pages 139 to 151 Veterinary Formulae for horses, cows, calves, pigs and dogs. The referee is somewhat disappointed for not finding "cat remedies" in this chapter. Many of the given formulas, which by the way are real working formulas, can be turned into dollars and cents by the pharmacist in the form of a specialty. These formulas should also be considered by the A. Ph. A. Committee on Unofficial Formulas.

GRUNDZUEGE DER ANORGANISCHEN CHEMIE. Von Dr. phil. et ing. Ludwig Wolf. Mit 7 Abbildungen. Demy 8vo. 231 pp.

This book, written by an assistant at the Chemical Institute of the University of Berlin, presents in a condensed form the most important facts of inorganic chemistry. The introduction contains Theory and Laws, Part I the Non-Metals, and Part II the Metals. How thorough the subject is treated can be seen from the monograph on Sulphur, which contains the following matter: Etymology, Occurrence, Manufacture, Properties, Uses and Combinations as H_2S , SO_2 , H_2SO_3 , SO_3 , H_2SO_4 , $H_2S_2O_7$, $H_2S_2O_8$, H_2SO_5 , $H_2S_2O_4$, $H_2S_2O_3$, S_2Cl_2 , $SOCl_2$, SO_2Cl_2 , SO_3HCl and also a chapter on Volumetric Analysis and Iodometry.

The book is especially well adapted as a repetition for the student of pharmacy, chemistry and medicine.

EINFUEHUNG IN DIE CHEMIE DER KOHLENSTOFFVERBINDUNGEN. Von Dr. Emil Fromm, Professor der Chemie zu Wien. 4 Auflage. Demy 8vo. 262 pp.

It was the great Wilhelm Ostwald who made the classic remark in a paper on the History of Chemical Textbooks, "For the beginner a thorough, coherent explanation and presentation is far more necessary than completeness." The author followed his advice and has written a book which is well suited for the beginning of that complex study, Organic Chemistry. That the book has reached four editions, each succeeding one being improved, since 1905, speaks well for its usefulness. The book is well written and the explanations are strikingly clear and simple. A twelve-page, double-column index is also of great benefit.

Let us hope that this book, as well as other books from the "Deuticke-Verlag" will become better known in the United States!

OTTO RAUBENHEIMER, Ph. M.